





THE NAUTILUS

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DEVOTED TO THE INTERESTS
OF CONCHOLOGISTS

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Dr. GLENN R. WEBB, Kutztown State College, Kutztown, Pa.

THE NAUTILUS

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No. 1

ASPELLA (FAVARTIA) ANGERMEYERAE, N. SP.

BY WILLIAM K. EMERSON AND ANTHONY D'ATTILIO
American Museum of Natural History

Among material recently received from Mrs. Carmen Angermeyer of Academy Bay, Santa Cruz Island, Galapagos Islands, is an apparently undescribed species of a muricid gastropod of the subfamily Trophoninae. We take extreme pleasure in naming this interesting discovery for Mrs. Angermeyer, an avid collector of shells.

ASPELLA (FAVARTIA) ANGERMEYERAE, new species. Plate 1.

Shell is small, pear-shaped, with 4 whorls, a low spire, and is subangulate at shoulder, descending convexly and turning in towards the siphonal canal, which is moderate in length. The shell is sculptured by 7 rounded axial costae crossed by weaker spiral cords arranged thusly: Following the eroded protoconch, the heavy costae starting at the poorly defined suture descend diagonally towards the shoulder producing rounded pits in the intervening spaces; below the shoulder the costae descend parallel to the axis to form terminally the siphonal fasciole; terminal costae correspond to the consecutively formed earlier siphonal tips. The spiral cords appear first on the penultimate whorl and consist of a smaller cord centrally placed between the heavier cords located at the sutures; the body whorl above the shoulder is similar to the previous whorl; below the shoulder cord are four equal-size cords, and following thereafter is a single larger cord directly above the canal; the intersection of spiral and axial sculpture produces a series of large rounded elevations. Crossing spirally over the entire shell are fine punctured incised striae. The surface of the shell where not eroded consists of a fine chalk-white film which when worn away reveals a black coloration, the black appearing most intense at the intersection of spiral and axial sculpture. The elliptical aperture is lanceolate at both ends, with a moderately well defined posterior groove; the peristome is elevated around the columella; the labrum is crenulate with 6 wide grooves, the interspaces being white between; the aperture

is otherwise grey becoming darker in the grooved portions of the labrum. The anterior canal is closed, somewhat recurved, whitish near the aperture but darker grey to black at anterior end. A pseudo-umbilical chink is framed on the left side by the fasciole. Operculum is "muricoid" with a terminal, *i.e.*, basal nucleus.

Measurements: Holotype, length 20.7 mm., width 13.8 mm.; paratype, 20.3 mm. (spire incomplete), width 12.1 mm.

Type locality: Academy Bay, Santa Cruz Island, Galapagos Islands, intertidal zone.

Type specimens: Holotype, A.M.N.H. no. 113526; paratype, A.M.N.H. no. 111856, 10 fathoms off Rabida Island, Galapagos Islands; Mrs. Carmen Angermeyer collector.

In addition to the holotype, a single paratype of apparently younger age was available for study. In this specimen, the surface is sufficiently eroded to remove all traces of the chalky white layer; there are only six axial costae; the area of black coloration is much diminished, being restricted mostly on the upper portions of spiral and axial sculpture, the shell appearing otherwise white; the canal is proportionately longer and is narrowly opened.

Mr. Allyn G. Smith of the California Academy of Sciences kindly lent us Kodachrome transparencies of a third specimen of this new species that is in the collection of Mrs. Jacqueline DeRoy of Academy Bay, Santa Cruz Island, where the specimen was obtained from beach drift. This specimen appears to be quite similar to the holotype and possesses a well defined posterior siphonal groove.

After the first draft of this manuscript was completed, Mrs. DeRoy informed the junior author (in letter, December 2, 1964) that she now possesses two other specimens of this new species in addition to the one photographed by Mr. Smith. One of the additional specimens was taken alive in 6 fathoms on sandy bottom off Floreana Island and the other is a specimen, which was occupied by a hermit crab, that was taken from the beach at Academy Bay, Santa Cruz Island. Photographs kindly provided by Mrs. DeRoy of the three specimens in her collection indicate that two are mature specimens and one is a juvenile specimen (see pl. 1, figs. 3-5).

The new species, although superficially resembling *Maxiwellia gemma* (Sowerby, 1879), which ranges from Santa Barbara, Cali-

fornia to Punta San Hipolito, Baja California, Mexico, differs in several significant conchological characters. In *Maxwellia gemma*, the costae above the shoulder consist of blade-like varices recurved and ornamented on their edges with spines; the spines further appearing on the costae of the body whorl. In addition, the spire of *Maxwellia gemma* is more extruded and the rounded aperture lacks the posterior groove of *Aspella* (*Favartia*) *angermeyerae*, new species.

Passing mention should be made here to the status of *Murex pumilus* Broderip (1833), an apparently similar species that was briefly described, without an illustration, and was stated to have been collected by Hugh Cuming in the Galapagos Islands, "under stones." To the best of our knowledge, this species has never been figured, and additional specimens have not been reported, although Carpenter (1857) subsequently cited Broderip's original record for the Galapagos Islands. Tryon (1880:135) provided the following translation of the original Latin description of *Murex pumilus*, "Rhomboidal, five varicose, varices flattened, short, subrecurved, crenulate; dark brown, subfasciate with white; canal moderate, subrecurved; lip crenulate. L. 5 inches [sic, = .5 inches], lat. 3 inches [sic, = .3 inches]," and he suggested that it was "Probably a young shell." In an attempt to determine if the type material of this taxon is extant, we inquired of Mr. Norman Tebble, head of the Mollusca Section of the British Museum (Natural History), if the type specimen were in the Cuming collection. He kindly informed us (in letter, December 30, 1964) that the type is not in the British Museum. Therefore, until the identity of Broderip's taxon can be determined, *Murex pumilus* must remain a species inquirenda, and its possible relationship with the new species described herein can not be evaluated.

The generic placement of this new species presents some problems. The presence of a posterior groove suggests affinity with *Aspella* (sensu lato). Although an anal siphon is not developed in the type species of *Favartia*, a weakly formed posterior siphonal groove occurs in some species of *Aspella*, including *Aspella* (*Aspella*) *paupercula* (C. B. Adams, 1850) and *Aspella* (*Favartia*) *obtusa* (Sowerby, 1894). In addition to other conchological characters, the presence on the surface of the shell of the chalky-white,

calcareous layer that is characteristic of *Aspella* lends support to the assignment of this new species to *Favartia*. The nature of the radula, unfortunately, is not known.

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FOUR NEW LAND SNAILS FROM THE SOUTHEASTERN UNITED STATES

By LESLIE HUBRICHT

MESODON KALMIANUS, new species.

Pl. 2, figs. a-c.

Shell subglobose, spire elevated, conic, apex obtuse; tawny-olive, shining, translucent; umbilicate, the umbilicus nearly covered by the reflected peristome; whorls $4\frac{1}{2}$ to 5, regularly increasing, well rounded, last whorl descending and constricted behind the aperture; embryonic whorl nearly smooth, succeeding whorls with rib-striae, last two whorls with incised spiral lines which are more prominent on the base; aperture roundly lunate, oblique, peristome reflected, white.

Penis long, slender, with a small fleshy body in the upper end, without pilasters; vagina very short; spermatheca oblong, about twice as long as wide, duct very slender, about half as long as the penis. Penis 7 mm., vagina 0.3 mm., spermatheca 1 mm., duct 3.5 mm.

Diameter 9.2 mm., height 6.2 mm., aperture width 4.4 mm., aperture height 4.4 mm., whorls 4.8. Holotype.

Distribution: — *Kentucky*: Laurel Co.: near Laurel River, Lily, holotype 135311 and paratypes 135312 Chicago Natural History

Museum, other paratypes 17922, collection of the author. *Tennessee*: Scott Co.: near creek, 0.5 mile north of Glenmary. Morgan Co.: roadside, 2.3 miles north-northeast of Sunbright.

Mesodon kalmianus is most closely related to *M. downieanus* (Bland). The shell is more strongly rib-striate, and when fresh is darker colored. The penis in *M. downieanus* is only half as long and much stouter with a large fleshy body in the upper end. *M. kalmianus* is found on low ground near streams, while *M. downieanus* is found on the summits of sandstone mountains.

EUCONULUS DENTATUS (Sterki)

Euconulus chersinus dentatus (Sterki), Pilsbry, 1946, Acad. Nat. Sci. Philadelphia, Monographs 3, 2: 242-243.

Euconulus dentatus is a winter snail, being found from January to April, while *E. chersinus* (Say) is found throughout the year but is rare during the winter. *E. dentatus* is found in dryer habitats than those in which *E. chersinus* is usually found. The shell is smaller and the revolving striae on the base are usually more distinct.

GLYPHYALINIA SPECUS, new species.

Pl. 2, figs. d-f.

Shell small, depressed; subhyaline, shining; umbilicate, the umbilicus occupying about 23% of the diameter of the shell; whorls $4\frac{1}{2}$, well rounded, regularly increasing; sculptured above with distinct close-set radial striae, weaker on the base; spire very low conoid, sutures moderately impressed, margined; aperture oblique, lunate, a little wider than high, somewhat flattened above, base well rounded, lip simple.

Diameter 4.8 mm., height 2.3 mm., aperture width 2.2 mm., aperture height 1.8 mm, umbilicus diameter 1.1 mm., whorls 4.5. Holotype.

Distribution: — *Kentucky*: Edmonson Co.: in White Cave, Mammoth Cave National Park. Barren Co.: in James Cave, 1.5 miles northwest of Park City; in Beckton Cave, 0.5 mile northwest of Beckton, holotype 135315 C.N.H.M., paratypes 17218, collection of the author. *Tennessee*: Jackson Co.: in Hargis Cave, 1 mile north of Granville (Thomas C. Barr, Jr. coll.). Van Buren Co.: in McElroy Cave, 1.5 miles northeast of Bone Cave P. O. Grundy Co.: in Crystal Cave, 0.5 mile north of Piedmont.

Glyphyalinia specus is most closely related to *G. lewisiana* (Clapp), differing principally in its larger size. The animal is white and apparently blind. It is known only from the total darkness of caves.

PARAVITREA LAPILLA, new species.

Pl. 2, figs. g-d.

Shell small, pale buff, subhyaline, shining; spire low, convex,

with shallow sutures; whorls 7, slowly increasing, last quarter whorl expanded in mature shells; periphery somewhat flattened in young shells, becoming rounded when mature, deflected downward in last quarter whorl; umbilicus deep, well-like, occupying about 20% of the diameter of the shell; aperture oblique, lunate, wider than high, somewhat flattened on the base and above, lip thin, simple; sculpture of irregularly spaced radial grooves and growth wrinkles, distinct above but becoming obsolete on the base; there are two or three pairs of teeth within the last whorl at all stages of growth. Animal white.

Diameter 4.8 mm., height 2.2 mm., umbilicus diameter 1.0 mm., 7 whorls. Holotype.

Distribution: — *Tennessee*: Davidson Co.: Stones River bluff, Todd Knob, Donelson, holotype 135313 and paratypes 135314 C.N.H.M., other paratypes 29589, collection of the author.

Paravitrea lapilla is most closely related to *P. metallacta* Hubricht and *P. tantilla* Hubricht. It is larger than both, it has teeth in the adult shell as in *P. tantilla*, but the last whorl expands somewhat like *P. metallacta*, although not as much. It is more depressed than *P. capsella* (Gould), and the animal is white rather than pale slate-colored.

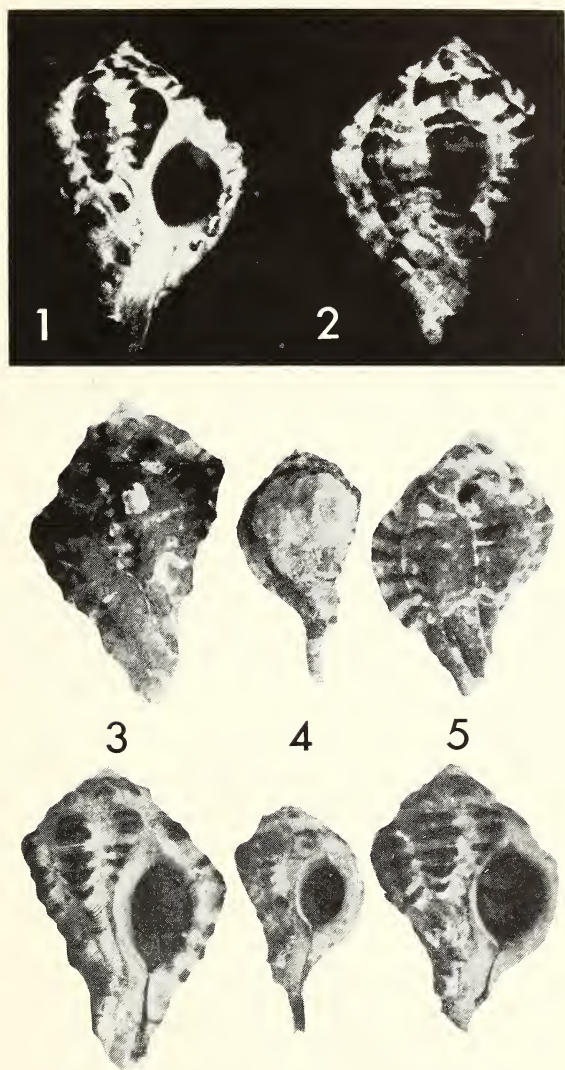
HELICODISCUS MULTIDENS Hubricht

This species was described from specimens collected in caves. It has since been found at the following two epigeal localities: *Tennessee*: Claiborne Co.: Indian Creek bluff, 0.5 mile above mouth. Smith Co.: wooded hillside, 1.5 miles southwest of Elmwood. A large series was collected at the last locality.

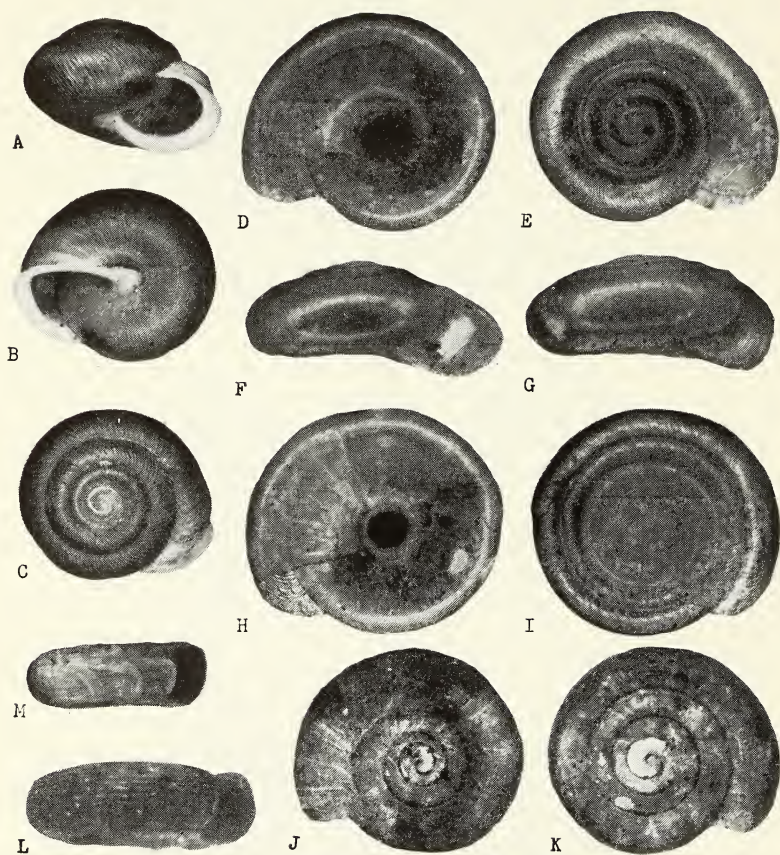
HELICODISCUS ENNEODON, new species.

Pl. 2, figs. j-m.

Shell small, discoidal, spire slightly concave; yellowish to brown, dull, opaque, whorls $4\frac{1}{2}$; umbilicus wide and shallow, showing all the whorls, occupying about 50% of the diameter of the shell; whorls somewhat flattened above the periphery, slowly increasing, the last descending behind the aperture; sculptured with numerous, fine epidermal fringes on lirae; aperture lunate, the peristome simple, somewhat thickened within; within the last quarter whorl there are 9 teeth, 3 pairs of teeth on the outer and basal walls, and alternating with them, 3 teeth on the parietal wall; the teeth on the outer and basal walls are radially elongate, raised on a heavy callous ridge, and separated by a rounded sinus; the parietal teeth are about twice as broad as high, the ends are turned forward, the upper end more so than the lower; of the 3 sets of teeth the center set is usually more fully developed than the others; as the shell grows, the teeth farthest within are absorbed and a new set added near the aperture.



Aspella (Favartia) angermeyerae Emerson & D'Attilio. Figs. 1, 2, holotype, male (A.M.N.H. no. 113526). Figs. 3-5, DeRoy collection. Figs. approximately $\times 2$.



Holotypes. A-C. *Mesodon kalmianus* Hubricht. D-F. *Glyphyalinia specus* Hubricht. G-I. *Paravitrea lapilla* Hubricht. J-L. *Helicodiscus enneodon* Hubricht. M. Paratype opened to show 3 parietal teeth. Photographs by Chicago Natural History Museum.

Diameter 4.3 mm., height 1.5 mm., 4.5 whorls. Holotype.

Distribution: — *Tennessee:* Claiborne Co.: on the undersides of stones, Clinch River bluff, 4.5 miles southeast of Springdale, holotype 135316 and paratypes 135317 C.N.H.M., other paratypes 32382, collection of the author. Anderson Co.: wooded hillside, 1.7 miles northeast of Clinton. Unicoi Co.: near Davis Springs, Limestone Cove, 5 miles east of Unicoi. Cocke Co.: French Broad River bluff, 5 miles east of Newport.

Helicodiscus enneodon is most closely related to *H. multidens* Hubricht. It differs in its depressed spire, heavier sculpture, and the flattened whorls above the periphery. *Helicodiscus enneodon* is probably the most primitive species in the genus. The other species evolving through reduction of teeth and sculpture as a result of a burrowing habit.

TWO GASTROPOD HOSTS OF THE PYRAMIDELLID GASTROPOD ODOSTOMIA BISUTURALIS¹

By AMELIE H. SCHELTEMA

Woods Hole Oceanographic Institution, Woods Hole, Massachusetts

The number of ectoparasitic pyramidellids seen actually feeding on their hosts has grown considerably since Fretter and Graham's statement (1949, repeated 1962) that the pyramidellids appear to be host-specific. These observations emphasize that many pyramidellid species are not specific in their host selection (Ankel and Christensen, 1963) and that the hosts include a wide variety of invertebrate organisms (Robertson and Orr, 1961). The hosts of *Odostomia bisuturalis* (Say) reported here give further evidence of these non-specific relationships.

Odostomia bisuturalis is commonly found below mean low water in Buzzards Bay in the vicinity of Woods Hole, Massachusetts. It clings to the underside of stones in rock areas where *Littorina littorea* is abundant.

The only host that *O. bisuturalis* has previously been reported to feed upon is the oyster *Crassostrea virginica* (Loosanoff, 1956; Merrill and Boss, 1964). Allen (1958) held *O. bisuturalis* in the laboratory with a variety of organisms, including *Bittium varium* and *C. virginica*, but it was not observed to feed.

I have made repeated collections of *O. bisuturalis* from two areas in Buzzards Bay: the stony shore at the town landing, Parker

¹ Contribution No. 1564, Woods Hole Oceanographic Institution.

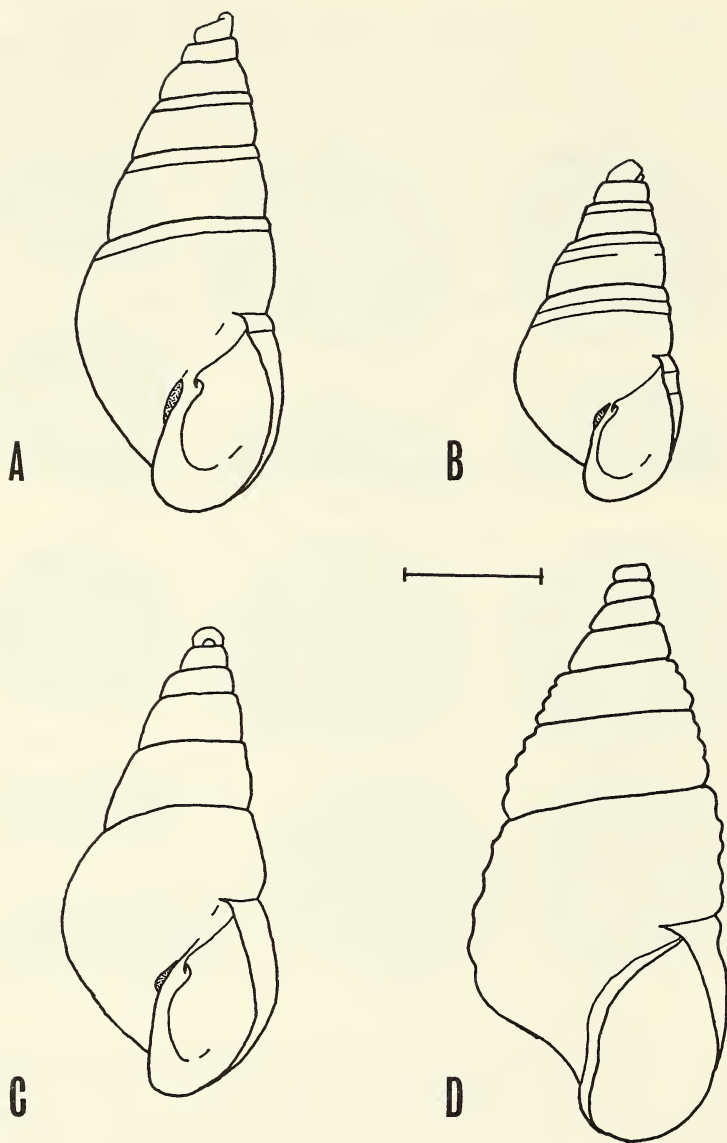


Figure 1. *Odostomia bisuturalis* (Say) (A, B, C) collected from Wood Neck Beach, Sippewissett, Falmouth, Massachusetts in July 1964. Shells oriented so as to show toothed columella. Note the variation in the number of spiral incised lines. All 3 fed concurrently on the *Bittium alternatum* (D, shell ornamentation not shown). Scale line equals 1 mm.

Street, Woods Hole, and a stony section of Wood Neck Beach, Sippewissett. A suspected host, the periwinkle *Littorina littorea*, was collected at the same time. *Bittium alternatum*, commonly found on eel grass, was taken as well from Wood Neck Beach, where eel grass and rocky shore forms are mixed owing to the abrupt changes in shore conditions over short distances.

A dozen or more *O. bisuturalis* were collected and placed together in a bowl with several *L. littorea* or *B. alternatum*. In every instance, *O. bisuturalis* was seen feeding upon the offered host, the long proboscis inserted into the mantle cavity and the buccal pump working. Figure 1 shows shells of three *O. bisuturalis* which fed concurrently on the illustrated *B. alternatum*, which is scarcely larger than its parasites. However, the ratio of *B. alternatum* to *O. bisuturalis* is many-fold greater at Wood Neck than in the laboratory observations. Ankel and Christensen (1963) have shown the same sort of relationship between *O. scalaris* and the diminutive *Hydrobia ulvae*, and Allen (1958) describes *O. impressa* (not a true *Odostomia* according to Robertson and Orr, 1961) feeding upon *Bittium varium*.

O. bisuturalis evidently moves about freely on rocks and can feed upon at least three organisms, the attached oyster and two non-sedentary herbivorous prosobranchs. It is found only subtidally, although two of its known hosts, *Littorina littorea* and the oyster, live both intertidally and subtidally. Egg masses have been found on stones in the collecting area at Parker Street identical to those laid by *O. bisuturalis* in the laboratory. In one instance, an egg mass was laid on the shell of a living *L. littorea* in the laboratory. *O. bisuturalis* was only once found on *L. littorea* in the field.

There is usually a variation in the number of spiral incised lines on the shells of any sample of *O. bisuturalis* collected from the same population, as shown in Figure 1.

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THE REVEREND JOHN LIGHTFOOT, DANIEL SOLANDER, AND THE PORTLAND CATALOGUE

By E. ALISON KAY¹

The thorny question of the authorship of a number of molluscan names first proposed in the "Portland Catalogue" has been discussed in the recent papers of Dance (1962) and Clench (1964). While zoologists now agree over the propriety of the names used, their authorship is still disputed: Coomans (1963) and Cox (1964) attribute the genus *Isognomon* to Lightfoot, Kohn (1964) attributes several species of the genus *Conus* to Lightfoot and others to "Solander in Lightfoot," while Clench (*op. cit.*) follows the practice of attributing to Solander the sole authorship of the valid volute species identified in the Catalogue by the letter "S."

The "Portland Catalogue" is well known in malacological circles not only as a sale catalogue of the immense collection of natural history curiosities amassed by Margaret Cavendish Bentinck, 2nd Duchess of Portland which was compiled after her death in 1785, but also as a document of nomenclatural significance. Iredale (1916) pointed out that it includes several validly introduced molluscan species. Although the identity of the compiler of the "Portland Catalogue," and hence the author of some of the valid molluscan names, is not apparent from the Catalogue itself, Dance (*op. cit.*) has presented convincing evidence establishing the Reverend John Lightfoot, librarian and chaplain to the Duchess of Portland, as author.

The problem of the authorship of the molluscan names validly

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introduced in the "Portland Catalogue" is, however, two-fold. In addition to names without an identifying initial and which are presumably the work of the author, there are a number of names identified by the letter "S.". These have generally been attributed to Daniel Solander because of a note in the List of References that "'S.' after one or more names refers to a manuscript copy of Descriptions of Shells made by the late Dr. Solander, now in the possession of Sir Joseph Banks, Bart., P. R. S." (Lightfoot, 1786). That Solander's authorship of the names identified by the "S." should be questioned was suggested by Dance (1962) as a result of his studies establishing Lightfoot a compiler of the "Portland Catalogue." Dance's (*ibid.*) comparison of the Solander manuscripts with the "Solander species" revealed several discrepancies: a number of species were not included in the manuscripts, the references to some species in the Catalogue differed from those in the manuscripts, and at least three in the Catalogue refer to Martyn's "Universal Conchologist," volume 1, which has an acknowledged publication date of 1784, two years after Solander's death. Dance (*ibid.*) concluded: "These discrepancies indicate that a number of the names bearing an 'S.' did not originate with Solander and to avoid confusion it may be preferable to attribute all of them to Lightfoot." Clench (1964), however, states that Dance's evidence is circumstantial and "... in no way proves that Lightfoot was the author of these discrepancies." Concerning the Martyn references, for example, he feels that since both Solander and Martyn worked on the Portland collection, Solander must have been aware of Martyn's first volume of "The Universal Conchologist" before its publication.

Despite Clench's (*ibid.*) argument, my own feeling is that neither the traditional citing of Solander as author of those species designated by the letter "S." in the Catalogue, nor Kohn's (1964) citation of "Solander in Lightfoot" is appropriate. The lack of congruence between the manuscripts and the Catalogue which was pointed out by Dance (1962) militates against considering Solander the sole author of the "S." species, while in Kohn's (*op. cit.*) usage there is implicit resort to a manuscript, but manuscripts have no legitimacy in nomenclature practice. Thus I favor the suggestion of Dance (*op. cit.*) because it patently reduces the possibility of future confusion.

Unfortunately, the arguments surrounding the authorship of the "S." species in the "Portland Catalogue" are based on scanty evidence. The initial study of the Solander manuscripts by Iredale (1916) was brief: "... from a glance over them it seems that Solander hoped to publish a Survey of Natural History, comparable to Linne's *Systema Naturae*, on an even more extensive and accurate scale." Wilkins (1955) also briefly touched on the manuscripts in his work on the Banks collection, and Dance's (*op. cit.*) study cites only selected discrepancies between the manuscripts and the "Portland Catalogue." Since resolution of the problem hinges on the nature of the "Manuscript Copy of descriptions of Shells made by the late Dr. Solander . . .", I have taken the opportunity to compare Solander's manuscripts which are now in the British Museum (Natural History) with a copy of the "Portland Catalogue" and to study early works and documents dealing with Solander's manuscripts in the same institution. The result is the following account of the Solander manuscripts and an interpretation of their relationship to the "Portland Catalogue."

The Solander manuscripts consist of several hundred 3 by 6 inch parchment slips in 27 leather-bound volumes, of which 14 deal with the "Mollusca" (including "Vermes," cirripedes, holothuroids, and coelenterates). Each molluscan genus is introduced by a general description, and is followed by a series of slips, one or more to a species, each with the Latin description, habitat if known, and a notation of the collections containing specimens studied by Solander, "M.C.P." (Duchess of Portland), "J.B." (Joseph Banks), and "M.B." (British Museum). Wilkins (1955) notes that frequently a slip has all three sets of initials—evidence that Solander utilized collections in addition to that of the Duchess of Portland in his ambitious work. Gray (1825) states that Solander also studied the collections of George Humphrey, but there is no indication of this in the manuscripts.

The volumes of the Solander manuscripts dealing with the bivalves and cephalopods appear to be complete: that is, they include not only the genera and species of the 12th edition of the *Systema Naturae*, but also a number of genera and species proposed by Solander. The volumes on the gastropods are manifestly incomplete; they include species descriptions from both the Sys-

tema and those which Solander proposed for *Conus*, *Cypraea*, *Bulla*, *Voluta* (including *Mitra* and *Oliwa*), and for a portion of *Buccinum*. The last pages of volume 13 and more than half of volume 14 are devoted simply to generic and specific descriptions for *Strombus*, *Murex*, *Trochus*, *Turbo*, and *Helix* from the *Systema*; the latter half of volume 14 includes only generic descriptions for *Haliotis*, *Patella*, and *Dentalium* from the *Systema*. There are no specific names proposed by Solander for the last 8 genera, nor is there any indication that he studied species of these genera in the London collections.

The manuscripts represent the extent of Solander's work on his project; he died in 1782 before completing the survey of natural history. A note dated Aug. 20, 1778 by Richard Pulteney (1730-1801) records the details of Solander's work on the Duchess of Portland's shell collection and includes a list of the genera completed by Solander which tallies with those listed above from the manuscripts; Pulteney states that ". . . the Buccina were unfinished . . ." (Pulteney Mss. No. 101, British Museum (Natural History)).

The history of the manuscripts subsequent to Solander's death must be inferred from several 18th and 19th century sources. A letter from Sir Joseph Banks to the Duchess of Portland in 1782 indicates that while the Duchess wanted to have Solander's work published Sir Joseph was opposed to the suggestion: ". . . I understand from Mr. Lightfoot that Your Grace is absolutely determined to publish the very unfinished descriptions of shells which my deces'd friend Dr. Solander made from your collection I know but too well that to publish them in their present state is absolutely unprofitable, or at least I am sure that Genera, without Characters, or even names, would suggest the idea of ridicule to the common reader." (Banks Letters, British Museum (Natural History)). Sir Joseph's view prevailed; the Solander manuscripts were not published but were available to other workers, first in the Banks library (Dillwyn, 1817), and later in the British Museum. Humphrey acknowledged his debt to the Solander manuscripts in the preparation of the *Museum Calonnianum* in 1797, and the works of Dillwyn (*op. cit.*), Swainson (1822), and Gray (1824-1828; 1858), among others, are replete with Solander manuscript names.

The relationship of the Solander manuscripts to the "Portland Catalogue" can best be clarified by a comparison of the manuscripts and the Catalogue (Table 1). Of the 62 valid molluscan species identified by the letter "S" in the Catalogue, 28 [45%] differ from Solander's manuscript entries: 6 species in the Catalogue are not included in the manuscripts;² 14 in the Catalogue are identified by references different from those cited in the manuscripts; seven in the Catalogue are introduced in the manuscripts but without references; and one, *Conus architalassus* of the Catalogue, is spelled differently in the manuscripts (*Conus archithalassus*). There are other differences: the Catalogue reference to "Martyr" is cited as "Mart." or "Martin." but the same abbreviations in the manuscript refer to Martini's "Conchylien Cabinet" (cf. Wilkins, 1955). While only a single reference is listed for the majority of species in the Catalogue, that reference is usually second or third in a list or four or more references in the manuscripts.

It is apparent that the manuscripts represent an ambitious project and that Solander utilized several natural history cabinets in London for study during the years 1778-1782; the "Portland Catalogue," on the other hand, is a sale catalogue of only one of these natural history collections, that of the Duchess of Portland which was compiled after her death in 1785. The discrepancies existing between the manuscripts and the Catalogue and the selective tenor of the Catalogue entries lead me to suggest that the Catalogue represents the first instance in which the Solander manuscripts were utilized by a worker after Solander's death. If one accepts John Lightfoot as author of the "Portland Catalogue," then one can imagine that when he was called upon in 1786 to compile the sale catalogue for the estate of the Duchess of Portland, he worked from the Solander manuscripts in the library of Sir Joseph Banks. He incorporated some of Solander's names into his manuscript, amended several of the references given by Solander, replaced certain figures with others, and included names of his own invention. He acknowledged his debt to Solander by the letter "S." after certain species, just as Dillwyn,

² Dillwyn (1817) was apparently the first to note a discrepancy between the manuscripts and the Catalogue, observing that *Conus nocturnus* "S." of the Catalogue was not to be found in the manuscripts.

Table 1

Comparison of the valid "S" species from the Portland Catalogue and the Solander manuscripts. Where the Catalogue and the manuscripts are in agreement, the species is merely listed, otherwise discrepancies are indicated. Collections are as Wilkins (1955) indicated: "MCP", Duchess of Portland; "JB", Joseph Banks; "MB", British Museum.

<u>Portland Catalogue</u>			<u>Solander Manuscripts</u>		
<u>Page</u>	<u>Lot</u>	<u>Species and Reference</u>	<u>Vol.</u>	<u>Species and Reference</u>	<u>Collection</u>
42	1001	Arca fusca, S.	5	Arca fusca	MCP; MB; JB
185	3947	Arca labiata, S.	--	NO ENTRY	
98	2158	Arca nodulosa, S.	5	Arca nodulosa	MCP; MB; JB
44	1055	Argonauta hians, S.	7	Argonauta hians	MCP
44	1055	Argonauta navicula, S.	7	Argonauta navicula	MCP
96	2120	Argonauta nodosa, S.	7	Argonauta nodosa	MCP
133	2961	Buccinum calcaratum, S.	12	Buccinum calcaratum	MCP
14	301	Buccinum iris, S.	--	NO ENTRY	
17	372	Buccinum monodon, S.	13	Buccinum monodon	MCP
		Mart. vol. 1 f. 10		NO REFERENCE	
88	1960	Buccinum pustulosum, S.	--	NO ENTRY	
142	3158	Buccinum taurinum, S.	--	NO ENTRY	
98	2148	Buccinum testudo, S.	13	Buccinum testudo	MCP
136	3030	Bulla vesicaria, S.		Bulla vesicaria	MCP; JB; MB
164	3561	Bulla zonata, S.		Bulla zonata	MCP
		Born Mus. Caes tab.		Argen. Conch. p.	
		ix, fig. 1		T. 17, F I	
116	2550	Cardium hystrix, S.	3	Cardium hystrix	MCP
155	3389	Cardium impressum, S.	3	Cardium impressum	MCP
		Born Mus. tab. 2		List. Conch.	
		fig. 15, 16		T 320 f. 157	
178	3825	Cardium protrusum, S.	3	Cardium protrusum	MCP
58	1358	Cardium robustum, S.	3	Cardium robustum	MCP
105	2297	Cardium spinosum, S.	3	Cardium spinosum	MCP
		Favanne 52. A. 2		NO REFERENCE	

96	2123	<i>Chama lazarus</i> var. <i>pannosus</i> , S. Rum. 48. 3	--	NO ENTRY	
76	1714	<i>Conus araneosus</i> , S.	8	<i>Conus araneosus</i>	MCP
189	4017	<i>Conus architalassus</i> , S.	8	CONUS ARCHITHALASSUS	MCP
44	1046	<i>Conus augur</i> , S.	8	<i>Conus augur</i>	MCP
160	3491	<i>Conus fuscatus</i> , S.	8	<i>Conus fuscatus</i>	MCP
116	2554	<i>Conus mappa</i> , S.	8	<i>Conus mappa</i>	MCP
156	3411	<i>Conus nocturnus</i> , S.	8	NO ENTRY	
67	1501	<i>Conus quercinus</i> , S.	8	<i>Conus quercinus</i>	MCP
180	3866	<i>Conus undulatus</i> , S. Gualt. 25 I	8	<i>Conus undulatus</i> Gualt.	MCP
50	1206	<i>Cypraea pantherina</i> , S. Lister 681. 28	9	<i>Cypraea pantherina</i> Martin Conch L. P. 334 T. 24, F. 235	MCP; MB
106	2230	<i>Cypraea pustulata</i> , S.	9	<i>Cypraea pustulata</i>	MCP; MB
9	176	<i>Isognoma</i> [<i>Ostrea</i> <i>isognomon</i> L. called <i>Isognoma lignea</i> by S.]	6	<i>Isognomon lignea</i>	MCP; JB
115	2516	<i>Isognoma rigida</i> , S.	6	<i>Isognomon rigida</i>	MCP; JB; MB
101	2216	<i>Lepas cornucopiae</i> , S. D'Argenville, 26. D	2	<i>Lepas Cornu Copiae</i> Argenv. Conch. Suppl. T 7 F. 5 Argenv. Conch. 322 T. 26 F. 2	----
27	626	<i>Mya gigas</i> , S. List. Conch. 414	2	<i>Mya gigas</i> Gualt. Test. T. 90 F. A	MCP
69	1560	<i>Mytilus castaneus</i> , S.	7	<i>Mytilus castaneus</i>	MCP
77	1718	<i>Mytilus lingua</i> , S. New name for <i>Patella</i> <i>unguis</i> L. Humphrey's Conchology, Pl. 2. Fig. 2	7	<i>Mytilus lingua</i> Pet. Gaz. p. 51, T. 32 F. 9.	MCP
182	3906	<i>Nautilus scrobiculatus</i> , S.	7	<i>Nautilus scrobiculatus</i>	MCP

136	3040	<i>Pinna rigida</i> , S. Knorr II, 26, 1	7	<i>Pinna rigida</i> Seb Mus. 3 p. 181 T. 91. F. 3	MCP
160	3487	<i>Solen rostratus</i> , S. Valentyn Bivalves, No. 5	2	<i>Solen rostratus</i> NO REFERENCE	MCP
10	187	<i>Tellina cruentae</i> , S. Knorr VI. 12. 1	3	<i>Tellina cruentae</i> NO REFERENCE	MCP; JB
137	3049	<i>Tellina marginalis</i> , S.	3	<i>Tellina marginalis</i>	MCP; MB
138	3047	<i>Venus arctica</i> , S.	4	<i>Venus arctica</i>	MCP; JB; MB
30	708	<i>Voluta amphora</i> , S.	11	<i>Voluta amphora</i>	MCP
84	1873	<i>Voluta ancilla</i> , S. D'Avila's Catalogue Vol. 1 Pl. 8 Fig. 5	11	<i>Voluta ancilla</i> Knorr Conch. 5 p. 38 T. 23 F. 2	MCP
76	1448	<i>Voluta angulata</i> , S. Martyn, Vol. IV 1325	11	<i>Voluta angulata</i> NO REFERENCE	MCP
64	1448	<i>Voluta anguria</i> , S.	11	<i>Voluta anguria</i>	MCP
26	611	<i>Voluta auransiaca</i> , S. Rumph. 37. 2	11	<i>Voluta auransiaca</i> Martin 3 p. 422 t. 120 F 1098 Cum Synon. Knorr Conch 5 p. T. 1 F. 1	MCP
96	2122	<i>Voluta cithara</i> , S.	11	<i>Voluta cithara</i>	MCP
30	707	<i>Voluta elongata</i> , S.	--	NO ENTRY	
76	1705	<i>Voluta filosa</i> , S. Martyn, Vol. 1, fig. 221	11	<i>Voluta filosa</i> Martin Conch 4 p. 229. T. 149. F. 1388, 1389. 1391 Cum Synonymie. Gualteri	MCP
103	2274	<i>Voluta gravis</i> , S.	11	<i>Voluta gravis</i>	MCP
137	3054	<i>Voluta haustum</i> , S.	11	<i>Voluta haustum</i>	MCP
183	3913	<i>Voluta imperialis</i> , S. Martyn, Vol. III. 934, 935	11	<i>Voluta imperialis</i> NO REFERENCE	MCP

96	2116	<i>Voluta incompta</i> , S.	11	<i>Voluta incompta</i>	MCP
		Martyn, Vol. 1, fig. 191		NO REFERENCE	
13	264	<i>Voluta incrassata</i> , S.	11	<i>Voluta incrassata</i>	MCP
41	969	<i>Voluta melo</i> , S.	11	<i>Voluta melo</i>	MCP
142	3142	<i>Voluta muricata</i> , S.	11	<i>Voluta muricata</i>	MCP
6	89	<i>Voluta nobilis</i> , S.	11	<i>Voluta nobilis</i>	MCP
		List. 799.6		Martin Conch 3	
				p. 54 t. 72	
				f 774 t. 73	
				f 775.776 cum	
				synonymies	

Gray, and Humphrey acknowledged it with "Sol. Mss." in their works.

Acknowledgments. I am indebted to the Trustees of the British Museum (Natural History) for their kind permission to study the documents which serve as a basis for this paper, to S. P. Dance for bringing to my attention the letter from Sir Joseph Banks to the Duchess of Portland, and to A. J. Bernatowicz for his helpful criticism of the manuscript.

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COMPARISON OF GENITALIA OF TWO SYMPATRIC SPECIES OF HAPLOTREMA

By CLARENCE A. PORTER*

In the Pacific northwest, the family Haplotrematidae is represented by two closely related species *Haplotrema vancouverense* and *Haplotrema sportella*. The species are described by Pilsbry (10) as having "depressed umbilicate and narrowed shells with an expanded peristome. The upper lip margin is usually curved downward." Pilsbry distinguishes *Haplotrema sportella* "as having a shell diameter 11-22 mm., with rather sharply close striae on the spire, whereas *H. vancouverense* has a shell diameter of 22-23 mm., with striations wrinkle-like and irregular."

The basis for identifying Pulmonata has been the shell characteristics; the height/diameter ratio; number of whorls; and radula formula. This system has been satisfactory for most gastropods where the shell characteristics are distinct and color patterns are consistent. In recent studies, the shell characteristics have not always been considered satisfactory for the classification of gastropods (1, 2, 8, & 9). Consequently, other methods have

* This work was carried out in the laboratory of Dr. Ivan Pratt, Department of Zoology, Oregon State University, Corvallis, Oregon.

been sought in order to solve the problems encountered.

Mead (8 & 9) studied the morphology of the genitalia of the pulmonates *Ariolimax* (Moersch) and *Achatinida*, and found distinct differences in the genital system between genera and species. As a result, he was able to revise the taxonomy of the west coast slugs of the genus *Ariolimax* (Moersch). Similarly, Abdel-Malik (1 & 2) was able to separate into two distant subfamilies *Heliosoma trivolvis* and *Biomphalaria boissyi* using the differences found in the histology of the genital organs. Boettger (3), Webb (12), and Franzen (5) used the morphology of the genitalia to separate the genera in the family Succineidae. Watson (11), Fretter (6), Johansson (8) and Creek (4) also found these structures useful and necessary in the identification of prosobranchs.

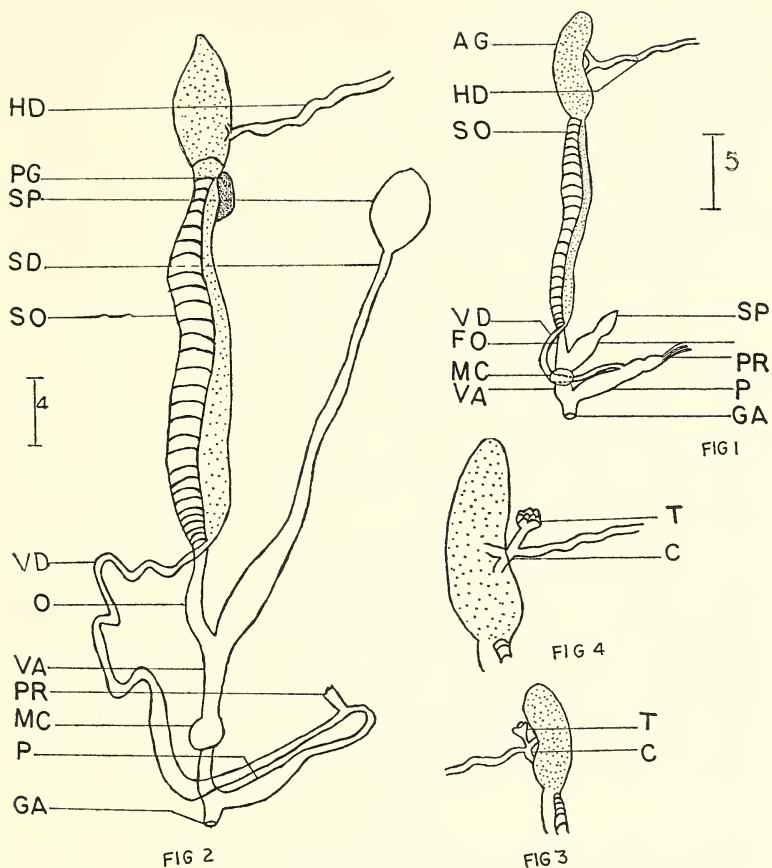
Because most of the descriptions of the Pacific northwest pulmonates are based upon somewhat inadequate shell and radula characteristics, the purpose of this study was to attempt to correlate the genital characters with radula and shell characters for the identification of these organisms.

Materials and Methods. The snails were collected from 4 stations within a radius of 25 miles from Corvallis, at sites which were characterized by an abundant growth of sword ferns and Douglas fir, in a moist habitat. The stations were located at (1) Woods Creek, 8 miles west of Philomath; (2) along the banks of the Alsea River, west of the town of Alsea; (3) near Burnt Woods, Oregon; and (4) Coffin Butte, north of Corvallis.

The snails were maintained in the laboratory in plastic terraria filled with soil and organic debris from the original habitat. The terraria were kept at approximately 65° F.

The snails were killed by leaving them in an Erlenmeyer flask filled with water for 18-24 hours. By this slow drowning method the snails were killed while in a relaxed state, and hardening and contraction of the tissues were reduced before fixation. The specimens were then dissected and the genitalia removed and measured in millimeters. The tissues were preserved in 70% alcohol and in Bouin's fluid.

A total of more than 35 animals and their shells were examined. All the snails studied were sexually mature and active although not all were fully grown. Drawings were made of the reproductive tracts and distinctive characteristics noted.



Figs. 1 & 3. *Haplotrema sportella*. 1, reproductive tract. 3, talon and albumen gland. Figs. 2 & 4. *H. vancouverense*. 2, reproductive tract. 4, talon and albumen gland. Key: HD, hermaphrodite duct. AG, albumen gland. SD, spermooviduct. C, region of carrefour. FO, free oviduct. VD, vas deferens. SP, spermatheca. PG, prostate. VG, vagina. GA, genital atrium. P, penis. MC, muscular collar.

It was found that the shell characters alone were not sufficient to determine the identification of the two species. Variations in the reproductive tracts of these two species proved to be useful in separating them and were used along with conventional methods. The data have been described and illustrated and measurements of the structures that vary in the two species have been made.

Differences in the reproductive tract. There are 3 basic differences in the morphology of the reproductive tracts of *Haplotrema sportella* and *H. vancouverense*. (1) The genus is characterized by a muscular collar on the vagina, but the location and form of the collar varies with the species. In *H. sportella*, the collar almost completely covers the vagina, which is 1.7 mm. long and is thick on the dorsal surface, but reduced to a narrow band on the ventral surface (Fig. 1). In *H. vancouverense*, the collar is large and muscular, covering about one-eighth of the median portion of the long vagina (7-13 mm.), and is incomplete on the ventral surface, (Fig. 2).

(2) The vas deferens is straight and narrow in *H. sportella*, (Fig. 1). In *H. vancouverense* it begins as a narrow tube, the lumen and areas of which increases approximately four times in diameter to the distal end, (Fig. 2). The overall length of the vas deferens is approximately 4 times greater in *H. vancouverense* (47-63 mm.) as compared to 10-21 mm. in *H. sportella*.

(3) The talon is long and has a spherical knob in *H. sportella* (Fig. 3); it is minute and clavate in *H. vancouverense*, (Fig. 4).

SUMMARY

Morphological data of the reproductive tract have been collected and applied to the scheme of classification of the two species of Haplotrematidae of the Pacific northwest to permit their identification.

The comparative location of the muscular collar on the vagina, the size of the vas deferens, and the shape and size of the talon are characteristic for each species. These combined with shell and radula characteristics make a more certain separation of the species possible.

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ON THE IDENTITY OF CONUS PASTINACA

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The confusion surrounding the correct identity of the taxon, *Conus pastinaca* Lamarck, 1810, has persisted for over a century. Lamarck (1810) proposed the taxon under the heading "[No.] 60 Cône panais. *Conus pastinaca*." A brief Latin description was given, followed by further remarks in French. No figures were cited. As to locality, Lamarck stated, "Habite . . . je le crois des même mers que le précédent [*Conus daucus*: Habite les mers de l'Amerique]." Lamarck stated that he felt *Conus pastinaca* "parôit distinct du cône carotte [*Conus daucus*]." Lamarck (1822) repeated virtually the same description. No figures were cited, nor was a locality given (other than "Habite . . . Mon cabinet").

Kiener (1847) subsequently described and figured a shell under the name of *Conus pastinaca* (on the same plate with *Conus daucus*). Reeve (1849) stated that Kiener's figure was "not the shell which I take to be the *Conus pastinaca*." Wein-kauff (1875) added that Kiener "gab dafur [*C. pastinaca*] eine blassgelbe varietät des *C. daucus*." Mermod (1947) stated "L'ex[emple] figuré dans Kiener . . . n'a pas été retrouvé. Lamarck dit que la spire n'est pas tachetée; Kiener, par contre, la dit et la figure mouchetée."

Tryon (1884) believed that "*Conus pastinaca* is a doubtful species, the specimens in the Lamarckian collection at Geneva including besides . . . [*Conus virgo*, other specimens with transverse lines, like those appearing on the body whorl of *Conus*

quercinus].” Mermod (1947) stated that Lamarck “possédait 3 ex[emplaires]. Dans sa coll[ection], un ex. de 31 mm., portant le n° 60, était mêlé aux *C. daucus*; c’est probablement le type du *pastinaca* de Lamarck.”

On the basis of the above information, one cannot precisely identify Lamarck’s *Conus pastinaca*. If it were of West Indian origin as Lamarck thought, it might be *Conus flavescens* Sowerby or *C. ustickei* Miller (in Usticke, 1959). Inasmuch as part of the Lamarckian collection is preserved in the Geneva Museum, an inquiry was made, and E. Binder of that institution kindly provided two photographs of the specimen mentioned by Mermod. The holotype of *Conus pastinaca* Lamarck is here illustrated for the first time (figs. 3, 4). These figures would indicate that Lamarck’s *Conus pastinaca* is merely another form of *Conus daucus* Hwass in Bruguière, 1792. Inasmuch as specimens in the series of *Conus daucus* in the American Museum of Natural History matched Binder’s figures, Lamarck’s taxon should be added to the synonymy of *C. daucus*.

However, the name *Conus pastinaca* has been applied by many workers to a quite different shell for many years. Reeve (1844) was first to describe and figure a second species under the name *Conus pastinaca*. Reeve’s concept was apparently based on a literal interpretation of Lamarck’s description. Kiener, however, was probably familiar with the specimens in Lamarck’s collection, and his larger, colorful specimen from the collection of de Lessert (*vide* Mermod), was in the original concept. Reeve did not give any locality for his species. Sowerby (1857-58) and Weinkauff (1875) described and figured the same shell as given by Reeve. Tryon (1884) stated that “The shells figured by Reeve, Weinkauff, and Sowerby for *Conus pastinaca*, Lam., are probably worn specimens of [*Conus virgo*].”

In addition, mention should be made of the fact that the name *C. pastinaca* has been incorrectly applied for many years to an entirely different species, now known to occur in New Caledonia. Crosse (1858) proposed the name *Conus coelinae* for a rather large, pale yellowish *Conus* from New Caledonia. Here again, confusion has persisted for over a century as to the correct spelling of the taxon. In the original paper, the name was printed throughout with ligatures for both pairs of vowels, the final “ae”

closely resembling that used for the first ligature following the "c." Bernardi (1861) spelled it *C. caelinae*, though amended it to *C. coelinae* on the Errata sheet. Sowerby (1866), Weinkauff (1875), and Barros e Cunha (1933), consistently spelled it *C. caelinae*. Tryon (1884) and Tomlin (1937) employed the *C. coelinae* spelling. Wagner and Abbott (1964) follow Tomlin (1937) in attributing the *C. caelinae* spelling to "Barros e Cunha, 1933," although this spelling was widely used in the 19th Century.

Crosse (1858) placed the name at the beginning of the "C's" in his "Catalogue alphabétique des Cones," as though it were intended to be spelled *Conus caelinae*. Leslie Taylor, Librarian, American Museum of Natural History, is of the opinion (personal communication) that this placement as well as the use of the ligatures to be merely faulty typesetting. The derivation of the specific name, incidentally, *coelia* in Latin, is from the Greek, *koilia*, a cavity.

For years workers have stated that *Conus coelinae* Crosse together with *C. emaciatius* Reeve, and (more recently) *C. spiceri* Bartsch and Rehder, were probably evolved from the wide-ranging *Conus virgo*. This concept, based entirely on shell characters, has not been verified by anatomical studies.

Synonymies of both species follow:

Conus (Lithoconus) daucus Hwass in Bruguière, 1792, form *pastinaca* Lamarck, 1810.

Conus pastinaca Lamarck, 1810: 266, no. 60.

Conus pastinaca Lamarck, 1822: 469, no. 60.

Conus pastinaca Kiener: 1847: 100. Plate 26, fig. 2.

Conus (Lithoconus) coelinae Crosse, 1858.

Conus pastinaca Lamarck, Reeve, 1844. Plate 46, sp. 257. *Non* Lamarck, 1810.

Conus pastinaca Lamarck, Sowerby, 1857-8: 22. Plate 15, fig. 353.

Conus coelinae Crosse, 1858: 117. Plate 2, fig. 1.

Conus coelinae Bernardi, 1866: 6. Plate 2, fig. 11.

Conus coelinae "Bernard" Crosse, Sowerby, 1866: 326. Plate 26, fig. 623.

Conus pastinaca Lamarck, Weinkauff, 1875: 219. Plate 32, fig. 1, 2. *Non* Lamarck, 1810.

Conus virgo var. *coelinae* Crosse, Tryon, 1884: 43. Plate 13, fig. 46.

Conus virgo caelinae Crosse, Barros e Cunha, 1933: 95.

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NEW RECORDS FOR CYPRAEA SURINAMENSIS

BY WILLIAM K. EMERSON AND WILLIAM E. OLD, JR.

American Museum of Natural History

Cypraea (Propustularia) surinamensis Perry (1811), the least known of the western Atlantic cowries, was previously recorded from several islands in the southern part of the Caribbean Sea and from the adjacent coast of South America at Surinam (Dutch Guiana). However, this taxon, or one of its supposed synonyms: *C. bicallosa* Gray (1831), *C. aubryana* Jousseaume (1869), and

C. ingloria Crosse (1878), was also cited from Vera Cruz, Mexico, and Equatorial Africa, in addition to St. Thomas, Guadeloupe, Marie Galante, Martinique, St. Vincent, Aruba and Curaçao in the Lesser Antilles, and Surinam. The African locality is certainly an error, and the Mexican record has been questioned in recent years.

Coomans (1963), in a review of the literature pertaining to this species, noted that all the then recorded occurrences were based on specimens collected in the nineteenth century, with one exception. A specimen was obtained from a power dredge, in 20 feet, at Barcadera, Aruba (Usticke, 1962). The recent discovery of additional specimens that extend the known range of this species to the Florida Keys, therefore, merits recording at this time. The new records are: 1) Fragments of the basal part of two specimens obtained by Harry G. Lee while skin diving off Punta Arenas, Mona Island, Puerto Rico (A.M.N.H. No. 112713; Jane Zager Collection). 2) A complete, dead specimen, lacking locality data, but presumably from Puerto Rico, where Mr. Lee purchased it (Lee Collection; pl. 3, fig. 1). 3) And a well-preserved, dead specimen that possesses a high gloss, dredged from rocky bottom, at a depth of 150 feet, one mile east of the Alligator Reef Lighthouse, off the Matecumber Keys, Florida by James Moore (A.M.N.H. No. 117176; pl. 3, fig. 2). Dr. R. Tucker Abbott has informed us (in letter) that a dead specimen was recently taken on Seranilla Bank, 300 miles east of Honduras.

The known records, all apparently based on dead specimens, indicate that this species may be expected to occur in suitable habitats from the Florida Keys southward, possibly to the equator. This species, however, will remain a rarity until its ecological station is discovered.

Mention should be made to the striking degree of dimorphism exhibited by the shells of this species. An examination of the illustrations in the literature and the 4 specimens available to us for study indicates that two distinct morphological forms exist. One has a narrow, somewhat compressed shell with weakly developed marginal calluses. The other form is characterized by a stouter, more inflated shell with heavier calluses developed on mature specimens. The two forms are illustrated herein (pl. 3, figs. 1, 2). The taxonomic significance of these forms cannot be

determined on the basis of the available data. They may merely represent sexual dimorphism, or possibly ecologically induced phenotypes. On the other hand, subspecific allocations would be indicated for the forms, if an allopatric distribution for the two forms were demonstrable.

Schilder and Schilder (1938) record the occurrence of *Cypraea barbadensis* (Schilder, 1932), which they consider to be the precursor of *C. surinamensis*, from Plio-Pleistocene deposits of Haiti and the Lesser Antilles. They remark that the fossils are smaller than living specimens of *C. surinamensis*, have the right side less margined, the posterior callosity less marked, and the aperture less curved. No mention is made, however, of the presence of shell dimorphism.

It is appropriate here to comment on the nomenclatural problems that confront students of this species. The use of *Cypraea surinamensis* Perry (1811, pl. 20, fig. 4) for this species is based on an extremely fanciful drawing and the stated locality "Surinam." To the best of our knowledge, there is no evidence that this species actually occurs in Surinam.¹ Unfortunately, most of the localities given in Perry's *Conchology* are wrong. For example, on plate 20, with *C. surinamensis*, only one of the better-executed, recognizable drawings is correctly localized. Note that Gray (1828), who was the first contemporary worker to accept Perry's new taxons and, according to Wilkins (1957), had access to some of the collections on which Perry based his illustrations, did not recognize *C. surinamensis*. In fact, Gray (1831:35) adequately described the present species as *C. bicallosa*, without reference to a locality, on the basis of specimens from 4 private collections. Sowerby (1832, pl. 2, fig. 10) subsequently figured a specimen that is similar to the narrow form of the present species. Inasmuch as there can be no doubt that Gray's taxon is applicable to the present species and Perry's taxon is based on very questionable data, it is unfortunate that *Cypraea surinamensis* was resurrected for the present species by Schilder (1924; 1927), who considered Perry's figure to represent a beach worn specimen of

¹ Shaw (1909) rejected Surinam. Most workers before Schilder (1932a) cited Perry's *C. surinamensis* from West Africa, believing it to be *C. (Zonaria) gambiensis* Shaw, 1909 [= *C. nebulosa* Kiener, 1843, *non* Gmelin, 1791]. Mörch (1877) recorded Perry's taxon from "Kurachie" [Pakistan].

C. bicallosa. In our opinion, Perry's taxon, in absence of the type material, should have been considered a "species inquirenda," with *C. bicallosa* Gray retained as the first available name for the present species. We have been constrained, however, to use Perry's taxon for the present species in the interest of nomenclatural stability.

Cypraea aubyra Jousseaume (1869:348, pl. 18, figs. 1-3) was described from a single specimen that had been "... partie d'une collection de la Guadeloupe, achetée par le Musée des colonies." No similar specimens have been subsequently reported from the Caribbean area. In the present century, this taxon has been considered by several writers to be an immature example of *C. bicallosa* or of *C. surinamensis*. The type, however, is a large specimen, measuring 48 mm. in length, that has well-developed apertural teeth. Schilder and Schilder (1964) record it as the largest known specimen of *C. surinamensis*. Although we have not seen the type specimen, our evaluation of the original description and figures leads us to believe that *C. aubyra* was based on a mature specimen which may be referable to the subgenus *Callistocypraea*, a group represented by living species in the Indo-Pacific province. Whereas the mature specimen of the present species reported above from off the Florida Keys is only 38 mm. long and has 26 labial and 21 columellar teeth, the type of *C. aubyra* was stated to have only 27 labial and 22 columellar teeth, but it has a shell one-fourth again larger than the smaller Floridian specimen. These differences in shell characters suggest that Jousseaume's taxon probably is not referable to the present species, the stated locality, "Guadeloupe" [French West Indies], being erroneous.

Cypraea ingloria Crosse (1878:166, pl. 3, fig. 2), on the other hand, is apparently referable to the inflated form of the present species. Unaccountably, however, the type locality was given as "Côtes de l'Afrique méridionale." The type specimen measures 30 mm. in length and 19 mm. in width, and possesses 24 labial and 23 columellar teeth, characters which fall into the range of variation known for western Atlantic specimens.

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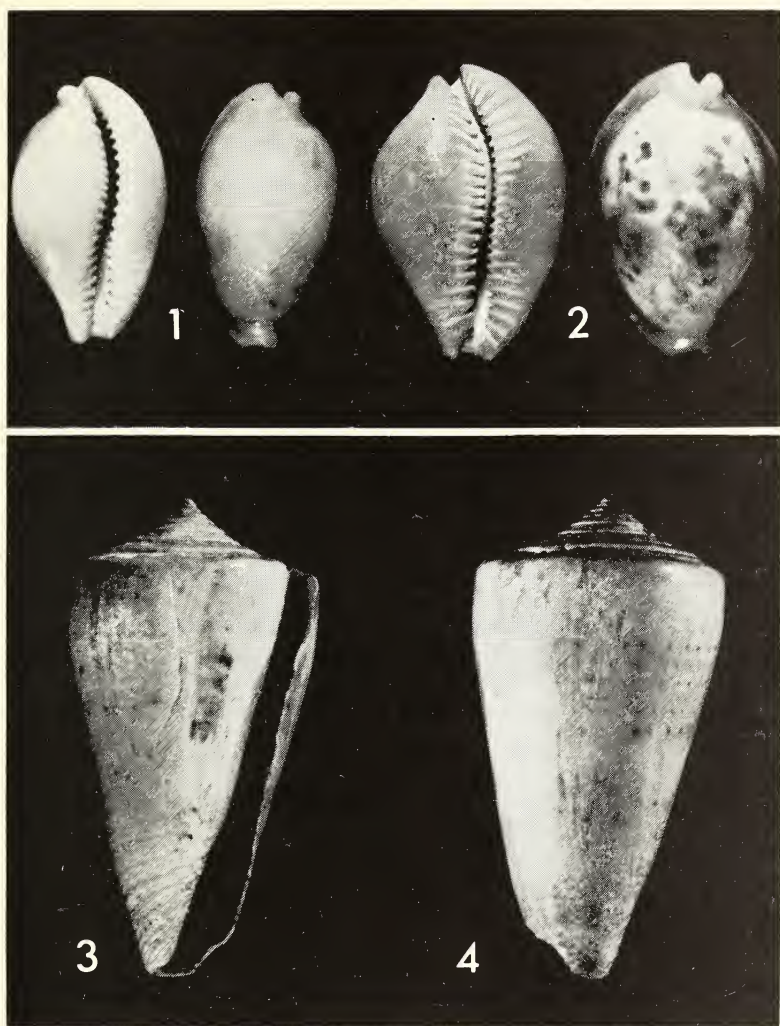
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A NEW SPECIES OF LITHASIA FROM MISSISSIPPI

BY WILLIAM J. CLENCH

Through the kindness of Mr. Leslie Hubricht of Meridian, Mississippi, I am privileged to report upon a new *Lithasia* from this state, the first species recorded south of the Tennessee River. The few species known under this generic name from the Coosa-Alabama River in Alabama are all members of the genus *Gonio-basis*.



Figs. 1, 2. *Cypraea (Propustularia) surinamensis* Perry. Fig. 1, "narrow form," specimen purchased in Puerto Rico (Lee collection). Fig. 2, "inflated form," off Matecumbe Keys, Florida (A.M.N.H. No. 117176, *ex* Moore collection). $\times 1$. Figs. 3, 4. *Conus pastinacea* Lamarck, 1810. Fig. 3, apertural view of holotype; fig. 4, dorsal view. Photographs courtesy Geneva Museum. Figs. approximately $\times 2$.

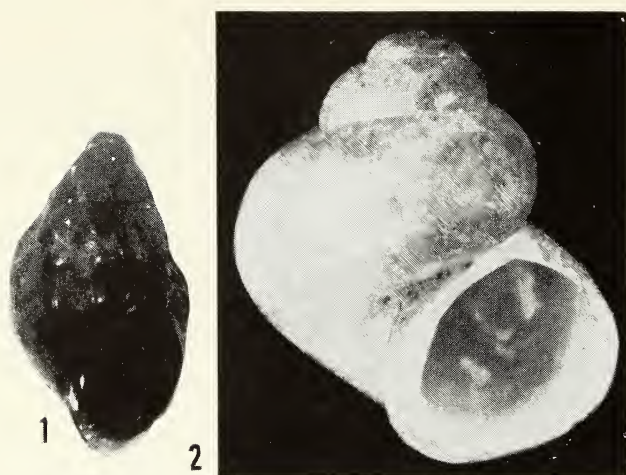


Fig. 1, *Lithasia hubrichti* Clench (2 \times). Fig. 2, *Clappia cahabensis* Clench (16 \times).

The genus *Lithasia*, as presently considered and understood, has heretofore been known only from the vast Ohio River System and in the Black and Spring rivers of Lawrence County, Arkansas. The various species prefer a rocky substrate usually where there is a fair to a swift current.

This new species may well represent a relict species, remaining in this area when this genus had a wider distribution than it now has.

The Mississippi River below the mouth of the Missouri River has a very depauperate molluscan fauna. This, of course, does not include the numerous Oxbow lakes which were parts of the main river in its past history, but even these Oxbow lakes present a very different environment than a flowing river.

If the lower Mississippi River ever had even a modest endemic molluscan fauna, it disappeared during the Cretaceous or the early Tertiary when the Missouri carried into the Mississippi the sand and silt of the Dakota Bad Lands.

Comparatively little is known about the fresh-water gastropods of the state of Mississippi and but little more is known about the fresh-water bivalves.

LITHASIA HUBRICHTI, new species.

Fig. 1.

Shell relatively small in size, reaching 20 mm. in length, sculptured and imperforate. Color a dark yellowish brown. Whorls

8 to 9 and moderately convex. Spire extended and produced at an angle of 60° . Aperture subovate. Siphonal canal small. Outer lip simple. Inner lip somewhat thickened in the columellar area. Columella short and vertical. Suture impressed. Sculpture axially tuberculate above the periphery; this in addition to the fine to coarse axial growth lines.

length	width	
20 mm.*	11.2 mm.	Holotype
19	10.4	Paratype
17.5	10.5	"

* Loss of one to two millimeters by corrosion.

Types. Holotype, Museum of Comparative Zoology no. 250916 from the Big Black River, 3 miles NW of Edwards, Hinds Co., Mississippi, Leslie Hubricht collector, October 12, 1963. Paratypes, Museum of Comparative Zoology no. 233392 from the same locality.

Remarks. This species differs from *Lithasia verrucosa* Rafinesque, its nearest in relationship, by being darker in color, having the tuberculate sculpture axial in arrangement rather than spiral and in having the tuberculate sculpture only above the whorl periphery.

A NEW SPECIES OF CLAPPIA FROM ALABAMA

By WILLIAM J. CLENCH

CLAPPIA CAHABENSIS, new species.

Fig. 2.

Shell small, reaching 3 mm. in length, umbilicate, and smooth. Color a yellowish brown, whorls 3.5, strongly convex. Suture indented. Spire extended. Aperture subcircular, slightly flaring, holostomatous and attached to the body whorl only at its upper part. Umbilicus narrow and deep. No sculpture. Periostracum thin. Operculum paucispiral with the nucleus nearly centered. Animal white.

length	width	
3.5 mm.	2.7 mm.	Holotype
3	2.4	Paratype

Types. Holotype, Museum of Comparative Zoology no. 251167, from the Cahaba River, 1 mile north of Centreville, Bibb Co., Alabama, Leslie Hubricht collector, Nov. 18, 1964.

Remarks. This is the second known species in the genus *Clappia*. The type species, *C. clappi* Walker is known from the Coosa River at Duncan's Ripple, The Bar, and Higgin's Ferry, all in Chilton County; and Butting Ram Shoals in Coosa County,

Alabama. The Cahaba River at Centreville is 160 river miles from the southmost Coosa locality.

This species differs from *C. clappi* by being proportionately more attenuate, having a smaller umbilicus and a less flaring margin of the aperture. Walker stated that the animal was black in *C. clappi* (Nautilus 22: 90). The soft anatomy of *C. cahabensis* is white.

NOTES AND NEWS

DATES OF THE NAUTILUS. — Vol. 78, no. 1, pp. 1-36, pls. 1-4, was mailed July 6, 1964. No. 2, pp. 37-72, October 11, 1964. No. 3, pp. 73-108, iii, January 25, 1965. No. 4, pp. 109-144 [iii], pls. 5-9, and Index, pp. iii-vii, April 20, 1965. — H.B.B.

MATINGS BETWEEN *POLYGYRA cereolus carpenterianus* and *P. septemvolvis* — The specimens of the present observations were collected or laboratory raised from specimens taken in the region of Miami, Florida. Here the two seeming species are distinct in shell and body characteristics. The genitalia are quite similar in the two species, and for this reason special efforts were made to see if mating could occur between them. The several observations secured are presented here, but further study should be made before the problem is considered closed. Webb, 1950, has described the eratology of *Polygyra septemvolvis* (Say).

The first possibly successful mating between the two species was noted August 3, 1950, when a group of both species were placed in a common cage. Soon thereafter I observed a specimen of *Polygyra cereolus carpenterianus* (Bland) with its sex-organ (penis) engaging that of a specimen of *septemvolvis*. After noting that the pair seemed to have the penes entwisted, I gently disengaged the specimens by pulling them apart from their sexual union to verify actual reciprocal entwistment of the penes. The manipulation confirmed my supposition. The organ of the *septemvolvis* was the longer, and wrapped about the other's organ. This observation indicates that possibly reciprocal insemination can occur between the two species, and if interfertile, hybrids may be produced. Neither genitalia nor behavior are insuperable barriers to inter-matings and possible resultant hybridization.

On March 15, 1951, again a mixture of both species were engaged together. Ultimately a *cereolus* engaged in courtship with a *septemvolvis* as they clung from the cage cover-glass. No biting was observed. The pair soon everted the penes and on 5 different instances tried to entwist them together. The penis of the *septemvolvis* was the larger, and seemed as it everted to volute outward from that of the *cereolus* such that a continuation of entwistment to the climax of mating (semen ejection) was never achieved. Thus preoccupied, I failed to see the courtship of a second pair in the cage, which were first seen with the penes successfully engaged. This pair soon disengaged the united penes in a manner normal for their species. The first pair never succeeded in uniting the sex-organs and ultimately separated.

The last normal attempted inter-species mating I have so far observed occurred March 29, 1951. A *cereolus* was seen courting a specimen of *septemvolvis*. Eight times the pair attempted and failed to entwist the penes. Each time the tip of one's penis everted free of the entwisted basal parts of the penes and partly entwisted on itself. When this occurred the pair separated their organs and tried again. In two of these attempts, I observed that the *cereolus* had the oddly everting organ. The pair briefly separated after these 8 attempts at mating. After a short interval they rejoined and made 3 more successive tries at penis-entwistment, all of these tries also failed as previously noted.

The observed data invite the conclusion that a partial genital isolation exists between these two species. One may also infer that semen ejection cannot be induced until the organs are entwisted reciprocally several times, and not just basally.

My final observation, also of March 29, 1951, records an abnormal courtship involving 3 specimens simultaneously, two *cereolus*, and one *septemvolvis*. Contrary to my expectation, the group reached the penis-entwistment stage in which the penis-bases were seemingly entwisted, but all 3 organs failed to unite properly for continued entwistment; retraction followed, and no further attempts at mating were observed of any of the group.

— GLENN R. WEBB, Kutztown State College, Pa.

HELIx POMATIA IN WISCONSIN. — In the spring of 1964, Michael Reineck, a student assistant at the University of Wisconsin, Mil-

waukee, brought to my attention a colony of *Helix pomatia* located north of Milwaukee. The colony occupies an undeveloped woodland area, approximately 20 feet north of where Pierron Road dead ends in the city of Glendale. The area is bounded on the north and west by houses, on the south by a dry creek bed, and on the east by the Milwaukee River. Members of the Reineck family have observed the colony every summer since 1956, and estimate the summer population to have varied from 50-100. Following information provided by another student, I subsequently located a second colony, one-half mile south on the river. This colony occupies approximately an acre of wooded land in Kletzche Park, just south of Green Tree Road. The wooded area is almost completely surrounded by a parking lot and park grass, and lies 300 feet from the river. A brief survey disclosed about 20 widely scattered animals and many shells.

In 1941, Dr. Robert Washburn of Milwaukee described a colony of *Helix* on the river "some 10 miles north of Milwaukee" (Nautilus 54 (4):145). In conversation with Dr. Washburn, I found this to be the Kletzche Park colony, which has apparently remained essentially unchanged in size and location for over 20 years.

According to William Dickinson of the Milwaukee Public Museum, *Helix* was introduced at the turn of the century to Pierron's Island, which is located in the Milwaukee River about 400 feet upstream from the Glendale colony. Relatives of Pierron who today use the island as a summer residence say that *Helix* is still present on the island. Probably the two mainland colonies were established by snails accidentally or purposefully removed from the island or, as suggested by Dr. Washburn, washed to the mainland by high water. — ANDREW McCLARY, Mich. State University, East Lansing, Michigan.

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THE PILSBRY QUARTERLY
DEVOTED TO THE INTERESTS OF CONCHOLOGISTS

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Dr. GLENN R. WEBB, Kutztown State College, Kutztown, Pa.

THE NAUTILUS

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No. 2

TWO NEW SPECIES OF CYPRAEA

By C. M. BURGESS

Honolulu, Hawaii

During the compilation of an illustrated text on the living *Cypraea* soon to be published, two species were noted which seemed different from all others in the genus. The distinguishing characters are all conchological, since no living specimens of either species have so far been recorded. However, these conchological characters are so distinct that by standards in use today description as new species seems justified.

CYPRAEA COHENAE, new species.

Plate 4 figs. A-D.

The holotype is well-preserved, fresh but empty. The shell is cylindrical and 25.5 to 29.4 mm. in length. The general shape is like that of *Cypraea edentula* Gray, 1824, but is larger and more elongated. The anterior extremity is attenuated and produced. The spire is depressed and the protoconch has the appearance of a glass bead. The dorsum is marked with sparse, discrete, circular, pale-brown spots 0.5 to 0.7 mm. in diameter, which are more numerous on the margins, but which extend onto both labial and columellar areas of the base. The columella is entirely smooth except for a prominent anterior terminal ridge and two or three weak crenulations immediately adjacent to the terminal ridge. The columellar portion of the posterior canal is short, and curves sharply to the left. It bears a prominent callus. There is a narrow but definite labial callus. The outer lip is well-developed and bears 17 deeply cut teeth which are heavily lined with golden brown. The gray-tan dorsum is faintly banded in the central area with darker tan.

This species is distinguishable from other South African cowries by its edentulous columella and the deeply denticulate labial margin of its aperture.

Paratype A is exactly the same general shape as the holotype. The columella is also smooth and the well-formed teeth on the outer lip number 16. The shell differs from the holotype only in

age. The paratype is a pearl-gray shell without other color, and is probably a subfossil.

Both specimens were collected on the beach at Jeffreys Bay, South Africa, by Mrs. Iris Cohen in April, 1964. She has made a careful search of available South African collections, and so far has been unable to discover another similar specimen. Although there are but two examples known, the conchological characters are so distinct that there seems no doubt that these two specimens represent a new species. I propose to call the new cowrie *Cypraea cohenae*, in honor of Mrs. Iris Cohen of Fish Hoek, South Africa. The holotype has been deposited in the Bernice P. Bishop Museum, Honolulu, Hawaii (B.B.M. 8911).

Type locality: The only 2 known specimens were found on the beach in Jeffreys Bay, South Africa.

CYPRAEA CASSIAUI, new species.

Plate 4 figs. E-H.

The shell is ovate, heavy and depressed, with prominent sharp margins. The aperture is narrow, slightly curved to the left; the posterior canal, however, is almost straight. The canals are light orange-brown, as is the base. The aperture is lined with coarse, deeply cut teeth. The fossula is deeply curved and ribbed (as is the entire columellar sulcus) and bears 5 or 6 inner denticles. The terminal ridge borders the canal and is slit. The bright, light orange-brown teeth cross the base and are doubly lined with dark orange-brown, which color extends as a single line on the ribs into the fossula and columellar sulcus. The teeth continue as ribs as they cross the lateral margins, fuse, intermingle, and become irregularly tuberculate as they approach the deep, trench-like dorsal groove. The orange-brown lines found on the base change to deep magenta exactly as they cross the lateral margins, where they also fuse into a single line, which broadens to stain the entire ridge joining the tubercles. The tubercles are encircled by magenta-colored lines. The ridges and tubercles end sharply at a trench-like, smooth, deep and sharply cut dorsal groove. No ridge or tubercle infringes into this groove, which extends along the entire dorsum, and the edges of which, even between the tubercles, project to nearly the same height.

About 4 years ago Dr. Pierre Cassiau of Papeete, Tahiti, sent me a specimen of this remarkable cowrie from the Marquesas

Islands for identification. It is a shell which superficially resembles *Cypraea granulata* Pease, 1862. However, there are two striking differences, the most obvious being the color characteristics. The base of the specimen is a brilliant light orange-brown, this color ending sharply at the lateral margins. The entire dorsum of the shell is a deep rose-purple, a color that I have never seen in any other cowrie. Subsequently, Dr. Cassiau sent me 6 additional shells.

I do not believe that general color variation is of significance in the determination of species. I do believe, however, that specific color characteristics limited to a certain area of the shell, i.e. spire blotches or spots, or both, are probably specific. The color combination described is constant even in beach-worn specimens in all 11 shells examined, and I believe it is significant. There is no suggestion of two-tone coloration of any shade in *Cypraea granulata*.

The most significant conchological difference manifested by this species is the dorsal groove. The groove is very deep and smooth because the edges are built up by an uninterrupted wall on each side, traversing the entire length of the shell. The groove is not a simple, shallow one between elevated tubercles such as occurs in *Cypraea granulata*. The extremities of *Cypraea cassiau* are noticeably more attenuated than those of *Cypraea granulata*, and the shell is more pointed.

Cypraea circercula Linn., 1758, may be differentiated by its more inflated cylindrical shape and its homogeneous yellow-brown color.

Four additional specimens of this species were sent to me for examination by Dr. Tucker Abbott of the Academy of Natural Sciences of Philadelphia. One specimen comparing in every significant conchological character to the holotype bears the number ANSP. 80063, (paratype E), and is from Starbuck Island in the Line Islands. Three more, also comparing in significant conchological characters to the holotype are in ANSP. no. 80860, (paratypes B,C,D), and are from Flint Island in eastern Polynesia (1901). Both lots were from the C. D. Voy collection.

All specimens so far have been beach-collected. Several, however, are fresh and hardly worn, as can be seen from the photo-

<u>cohenae</u>	Length Width Height (in millimeters)			Dentition Labial Columellar		Collection
Holotype	29.4	17.5	13.7	17	0	Bishop Museum
Paratype A	25.5	15.4	12.0	16	0	Iris Cohen
<u>cassiaui</u>						
Holotype	30.5	22.0	13.9	21	18	Bishop Museum
Paratype A	23.4	16.1	11.6	20	17	Pierre Cassiau
Paratype B	23.3	16.3	10.6	23	14	Academy Nat. Sciences (Flint Island)
Paratype C	24.8	16.8	11.0	21	17	Academy Nat. Sciences (Flint Island)
Paratype D	24.8	14.6	11.0	20	15	Academy Nat. Sciences (Flint Island)
Paratype E	21.8	14.0	9.8	20	16	Academy Nat. Sciences (Starbuck Island)
Paratype F	25.9	16.8	11.5	19	17	Jean Marie Frebault
Paratype G	25.9	17.2	11.5	21	17	Jean Marie Frebault
Paratype H	26.4	19.7	11.9	20	16?	Jean Marie Frebault
Paratype I	28.6	20.5	13.3	20	19	Rereao Krauser
Paratype J	28.1	21.1	13.7	22	?	Rereao Krauser

graph of the holotype. The freshest specimen has no gloss between the ridges and tubercles, in which characteristic it is similar to *Cypraea granulata*.

The species seems specifically different for the reasons listed. I propose to name this cowrie *Cypraea cassiaui* in honor of Dr. Pierre Cassiau of Papeete, Tahiti. The holotype (B.B.M. 8910) has been deposited in the Bernice P. Bishop Museum in Honolulu, Hawaii.

Type locality: This species so far is known only from the Marquesas, Starbuck, and Flint Islands in eastern Polynesia. The Marquesas are designated as the type locality. Paratypes from the Marquesas are also in the Jean Marie Frebault and Rereao Krauser collections in Tahiti.

A NEW CYPRAEA FROM EASTER ISLAND

By RAY SUMMERS, Petaluma, California, and

C. M. BURGESS, Honolulu, Hawaii

CYPRAEA ENGLERTI, *new species*.

Plate 4, figs. I-L

Two specimens of a distinctive cowrie were collected by Father Sebastian Englert on Easter Island and kindly forwarded to the senior author. These two apparently live-collected, perfect adult specimens seem adequate to establish a new species without question. It is a privilege to honor that devoted and self-sacrificing padre by giving his name to an endemic mollusk from his beloved island; *Cypraea englerti*, new species. The holotype, (Plate figs. I-L), has been deposited in the Bernice P. Bishop Museum in Honolulu, Hawaii (number B.B.M. 8909). The holotype measures (in millimeters) 22.8 in length, 17.0 in width, and 12.8 in height.

The shell of the holotype is solid, ovate and slightly pointed anteriorly where there are 5 right and 2 left lateral pits. The spire is slightly elevated and is covered with rust-colored nacre. There is a discrete white deposit of callus to the right of the spire. The dorsum is inflated and smooth with a prominent dorsal line.

The dorsal color is a homogeneous dark chocolate-brown, marked with discrete, circular, variable-sized, pure-white spots, (1.0 to 0.2 mm.), which are evenly distributed. The spots are rendered golden brown on the margins by an overlay above and obscured completely by a brownish-tan callus at the margins, both of which are prominent and sharp. This "café-au-lait" color extends across the base, becoming markedly darker in the mid-portion of the columellar base and then fading again to tan at the aperture. The aperture is cream, changing to pure-white in the fossula and columellar sulcus.

The fossula is deeply curved, well developed, and extends well into the interior of the shell. There are 5 strong white inner denticles, confined to the fossula. The heavy tan terminal ridge continues as the prominent anterior edge of the fossula. The columellar sulcus is smooth. The teeth are strong and deep, but only slightly produced. There are 17 labial teeth and 2 posterior crenulations within the posterior canal. There are 16 columellar teeth of similar size and appearance. The base is strongly convex and the aperture is curved slightly to the animal's left posteriorly.

The anterior and posterior canals are stained cafe-au-lait.

The paratype is the same in general appearance as the holotype, except that it is slightly less mature and the calloused margins are not quite so prominent. Labial teeth number 16 with 2 posterior crenulations within the canal. There are 15 columellar teeth. The first 4 have definite ribs extending a short distance into the fossula. There are 5 well developed inner denticles confined to the fossula, as in the holotype. The paratype measures (in millimeters) 24.3 in length, 16.9 in width, and 13.3 in height. The paratype is in the collection of the senior author.

This species is superficially similar to, but can be differentiated from, *Cypraea caputserpentis* Linn., 1758 and *Cypraea caputdraconis* Melvill, 1888. *Cypraea engleri* resembles these latter two species from a dorsal view, but can be separated at once by the presence of a strongly developed fossula. The aperture in *Cypraea engleri* is narrow and does not flare widely anteriorly as in *Cypraea caputdraconis*. Another distinguishing feature is the markedly convex base, which is in contrast to the concave or flat base of *Cypraea caputdraconis*. The teeth of *Cypraea engleri* are about the same width as the white to cream interstices. In *Cypraea caputdraconis* the interstices are much wider and furthermore are stained dark-brown to black. The soft parts are unknown. This is probably a shallow-water species collected on the reef.

Type locality: This species is known only from Easter Island, eastern Polynesia.

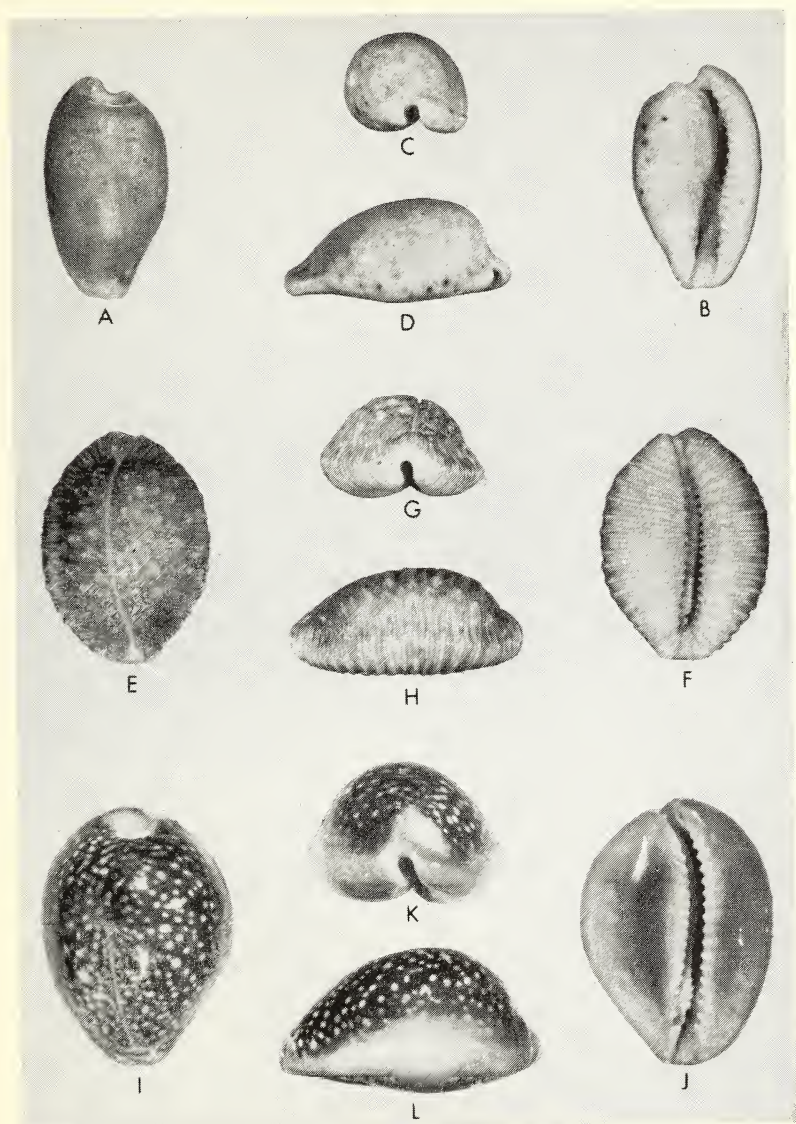
CORRECTIONS OF SPHAERIID NOMENCLATURE

BY H. B. HERRINGTON

Westbrook, Ontario

In these notes I wish to alter somewhat the nomenclature used in my monograph (Herrington, 1962).

A number of leading students of the Sphaeriidae continue to use the subgenus *Musculium* for the group containing *Sphaerium lacustre* (Müller), *S. partumeium* (Say), *S. securis* Prime, and *S. transversum* (Say). I consider this reasonable, and am now in the process of gathering the information necessary to provide equal status for other groups within the genus *Sphaerium*. See my monograph, pp. 7-9.



Figs. A-D holotype of *Cypraea cohenae* Burgess (length 29.4 mm.). Figs. E-H, holotype of *Cypraea cassiaui* Burgess (length 30.5 mm.). Figs. I-L, holotype of *Cypraea engleri* Summers and Burgess (length 22.8 mm.). Photography by Gilbert Halpern, Honolulu.

Last October H. B. Baker pointed out (Baker, 1964) that in rejecting the name *Sphaerium simile* (Say) for that of *S. sulcatum* (Lamarck), I erred in my interpretation of old terms (Herrington, 1950) Baker writes, "Herrington . . . seems to have been a bit confused. In bivalves, Say, like many of his contemporaries, for example Isaac Lea, used "breadth" to mean what we now call length, and employed 'length' for what we term height. They used diameter much as we do. This means that the missing type of *similis*, as Say measured it, was about 10.2 mm. long and 8.9 mm. in height (87% of length) . . ."

I put into all these terms a present-day content (as most people do when they read the King James version of the Bible). I acknowledge my error. Henceforth I shall label this species *Sphaerium simile* (Say) 1816, and not *S. sulcatum* (Lamarck) 1818.

Recently both Nils Hj. Odhner and J. G. J. Kuiper, partly in personal correspondence with me, have indicated that *Pisidium ventricosum* Prime and *P. rotundatum* Prime are not synonyms of *P. obtusale* Pfeiffer. In addition, on the basis of the ligament pit and other characters, Kuiper has pointed out that *P. punctiferum* (Guppy), *P. punctatum* Sterki and *P. tenuilineatum* Stelfox are each separate species (see Kuiper, 1962a and 1962b). These decisions are partly based on anatomical characteristics. I am, therefore, reverting to names previously in use in North America, viz. *P. ventricosum* Prime, and *P. ventricosum*, form *rotundatum* Prime, and *P. punctatum* Sterki.

Then there is the matter of *P. henslowanum* (Sheppard) and *P. supinum* Schmidt. Both are introduced species.

Among the shore debris at Athol Bay, Lake Ontario, Prince Edward County, Ontario, I have collected many thousands of *Pisidium* shells. Thousands of these belong to this *henslowanum-supinum* complex. Among these I found some typical *henslowanum* and some typical *supinum* and a multitude that were not typical of either. For this reason, and because I knew of two or three European students who suggested that the relationship between these might be that of species and form, I treated them, in my monograph, as *P. henslowanum* (Sheppard) and *P. henslowanum*, f. *supinum* Schmidt.

Early in 1963 I sent a quantity of these shells to Kuiper. I quote from his reply (May 27, 1963). "I agree with your identification of the species from the Athol Bay, Ontario Lake. Although not typical, it is, in my opinion, *Pisidium supinum* A. Schmidt. You prefer to consider it only as a form of *P. henslowanum* (Sheppard). I admit that it is often very difficult to separate museum series of both species. On the other hand, on the European continent, there are several localities in which *henslowanum* and *supinum* live together, without intermediate forms. This is the point of view of Ellis, too". As these are European species I am accepting his findings and henceforth will treat them as separate species.

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PALEOECOLOGIC INTERPRETATION AND THE IMPORT OF RECENT FAUNAS

By ERIC PANITZ

Department of Zoology, University of Kentucky, Lexington

Recently in the *Nautilus* (1964, 78:17-18), Nicol attempted to show that comparison of living species of major groups with their Paleozoic congeners would not reveal proper palaeoecologic conclusions. It is inferred that species must be compared only on a strictly morphological basis. Nicol infers that insects, known to be extremely large during the Pennsylvanian as compared to the recent, were large only as a stage in their evolutionary development.

It should be pointed out that any species develops as a result of the response of its epigenetic and genetic components to the environment in which it is found (Mayr, 1963), not the reverse

as Nicol implies. Since the insects of the Palaeozoic must have evolved in response to their environment, their morphologic evolutionary development will be a reflection of the effect of ecologic conditions (prior to and including that stage of development) on that species epigenesis.

It is an established generalization that the ratio of body surface area to volume is of great importance in the control of metabolism (Bergmann's Rule) by regulation of body heat. The insects, being of large surface area to low volume radiate comparatively more body heat (energy) in warmer climates than animals with lower surface area/volume ratios. The latter animals are generally found in colder climates, where of necessity they must conserve body heat. Thus the interpretation of the Pennsylvanian as having a rather warm tropical climate is quite proper.

The reason that pelecypods began to show their great diversity and adaptive radiation after the Palaeozoic is that ecologic conditions prior to this time were not such to permit the genetic component of these animals to expand into the niches that later became available. Since morphological and physiological characters are under control of the genetic component of the species, one cannot compare Palaeozoic and recent faunas on a strictly morphological basis. These characters must be compared on a basis that considers currently accepted physiological principles whose application may be inferred from the nature of the morphological structures. Thus an increase in the size of a species came about because the environment not only permitted it, but also require the species to undergo these epigenetic changes in order for it to survive in that environment. If the genetic composition of a species could not allow for the gross fluctuations that were gradually taking place in the environment, that species became extinct.

Many, if not all, of the ecogeographical rules can only be applied to terrestrial vertebrates. No parallels are known for aquatic or marine organisms, probably due to the temperature modifying influence of the vast masses of water. Proper inferences on invertebrates can be made if the physiological requirements of their environment are considered. In making interpretations of palaeocological conditions, the morphology of any group or species must be considered in light of currently existing physiological

principles. Principles which must have been in operation in the past as well as the present. A mere comparison of morphological characters, without consideration of their physiological and genetic implications will, of necessity, lead to a mis-interpretation of the paleo-environment in which the species possessing such characters dwelled.

Nicol may be correct in assuming that shell attached marine pelecypods were not present in Ordovician, Silurian, Devonian and Mississippian strata because they did not exist. Such pelecypods may not be found in colder marine seas today for reasons other than the morphological ones noted by Nicol (1964b). Oxygen or other dissolved gas content, lack of suitable food or the presence of some parasite may all be responsible for the observed lack of shell-attached pelecypods in Arctic and Antarctic seas. Finally, one should remember that far more than one group of marine animals must be considered in all their ecological, physiological and genetic implications and ramifications before such a broad generalization such as the temperatures of vast oceanic areas should be considered.

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GROWTH IN ONE SPECIES OF SPHAERIID CLAM*

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The growth of organisms in temporary ponds is of great interest because of the restrictions imposed on the animals by the environment. The following study on growth of *Sphaerium* (*Musculium*) *partumeium* was undertaken in an effort to find out under what conditions the clams are able to complete their life cycles in such a habitat.

* This study was a portion of research done in partial fulfillment of the requirements for the degree of Doctor of Philosophy at the University of Michigan. The author wishes to acknowledge the interest and encouragement of Dr. Frank E. Eggleton.

The field study was done during the spring on a pond described in a previous paper (Thomas 1963). The laboratory stock consisted of laboratory-born offspring of clams collected from the same pond.

Methods. Specimens of *Sphaerium partumeium* in the laboratory were grown in isolation, in dishes which contained water saturated with calcium salts, but with no aquatic plants or bottom material (Thomas 1954). The cultures were exposed to a fourteen-hour day and temperatures near 21° Centigrade. Twenty percent of them were aerated.

Young produced in these cultures were measured and isolated immediately. The only measurements which can be made readily on living specimens are of shell growth, so weekly records were made of two dimensions, the length (distance from extreme anterior to posterior ends) and height (distance from umbone to ventral edge).

Growth data on field specimens were obtained from a series of weekly collections begun in March when the pond filled with water and continued until it dried up at the end of July. Quantitative sampling was impossible because of the plant growth in the pond, but an effort was made to take approximately the same amount of bottom material in each collection. The samples were taken into the laboratory, sorted, and the clams found were measured and grouped into size classes.

Growth in Laboratory Cultures. The first sign of growth in laboratory-reared animals is a deposition along the ventral margin of the embryonal shell. Within a week after growth begins, shell material is also being added at the anterior and posterior ends, and for a short time the outline is roughly oval. This new portion is easily distinguishable for it has a delicate, translucent appearance and is deflected toward the midline from the edge of the embryonal shell. The two valves thus form a wide angle at the ventral edge. This angle decreases with the addition of increments at the edge, but at the same time the sulcus which sets off the embryonal shell becomes more distinct and produces the "capped" effect evident at all later stages. When the animal attains a length of about 2.5 mm an additional deposit along the posterior margin produces the somewhat truncated appearance characteristic of the species. In very old specimens, how-

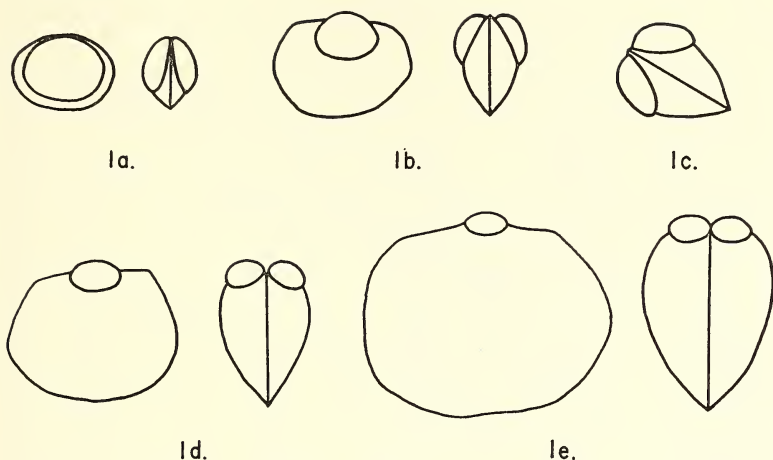


Figure 1. Deposition of shell material in a developing clam.
 (la.) at 1.8 mm (lb. and lc.) at 3.2 mm (ld.) at 5.1 mm
 (le.) at 9.0 mm

ever, a rounding of the outline is brought about once again by repeated increments on all free margins. (Figure 1a-e)

Growth of 6 laboratory specimens is plotted in Figure 2. The animals showed varying amounts of initial lag, but the slope of the line representing the 10 to 12 weeks of active growth is very similar in every case. The animals which showed no initial lag produced more generations in a given length of time than the others; their offspring likewise began to grow immediately. This characteristic is not correlated with birth size, age or size of parent.

The ratio of shell length to shell height was constant from the third or fourth week until the end. Although measurement through the umbones was not made, obviously the ratio of this dimension to the others changed markedly during the period of rapid growth. From about the third through the fifth week the animals are so obese that when laid on one side the dorso-ventral axis is inclined at a 35° angle, but as increments are added at the edge the obesity is correspondingly reduced. (Figure 1c)

Maximum size attained by the laboratory-reared clams was 7.17 by 6.92 mm. By arbitrarily taking a length of 4.0 mm as the lower limit of adult size the mean final size of 52 individuals raised was

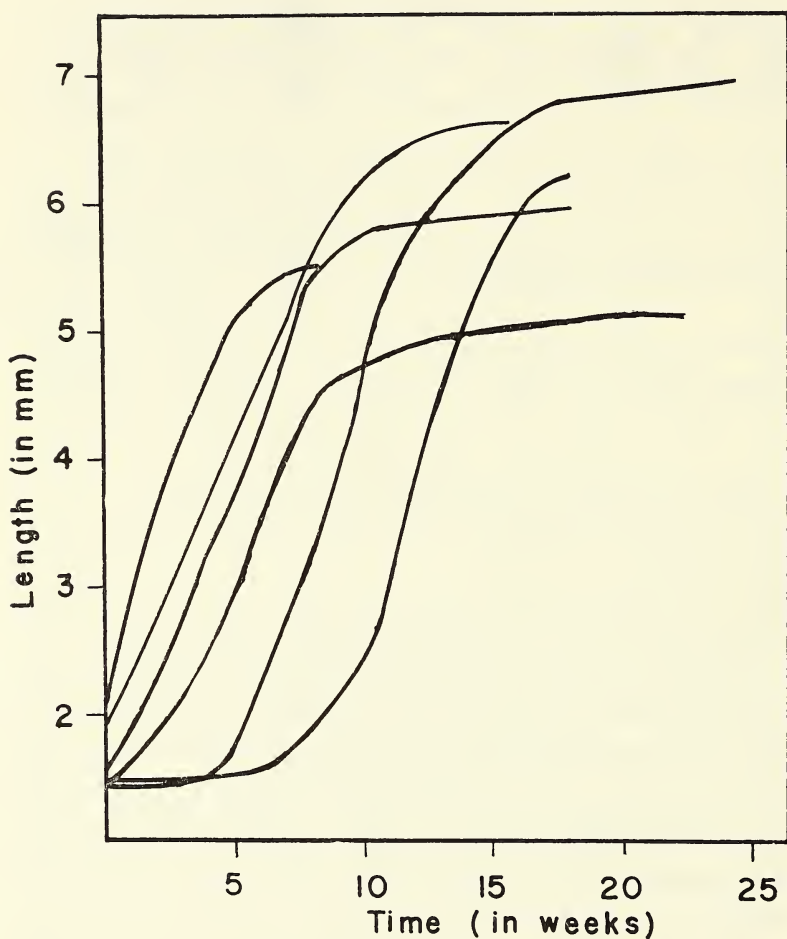


Figure 2. Growth curves based on measurement of shell length for six individuals reared in laboratory cultures.

5.54 by 4.86 mm. Only two of those individuals were in aerated culture dishes. Growth of clams was inhibited by the presence of ciliated protozoans.

Field Collections. At the time of the first collection in March, the pond had been filled with water for only a few days and had a thin ice cover. The water temperature near the bottom beneath the ice was 3° C. At the end of several weeks when the water temperature was elevated to about 8° C large masses of fila-

TABLE I

MEAN GROWTH MEASUREMENTS OF FIELD POPULATION

Collection Date	No. of Specimens	Mean Length (in mm)	Mean Height (in mm)	L/H
3/12	61	1.6	1.2	1.3
3/19	97	1.8	1.4	1.27
3/26	80	2.1	1.6	1.31
4/2	44	2.2	1.8	1.22
4/9	42	2.4	1.9	1.26
4/16	187	3.0	2.4	1.25
4/23	58	3.4	2.8	1.21
4/30	227	4.0	3.3	1.21
5/7	170	4.7	3.9	1.20
5/14	59	5.5	4.6	1.19
5/21	69	5.4	4.5	1.20
5/28	222	5.7	4.8	1.19
6/4	114	6.4	5.5	1.16
6/11	271	6.2	5.1	1.21
6/18	250	7.0	6.0	1.16
6/25	152	7.4	6.5	1.13
7/2	130	7.2	6.1	1.18
7/9	27	7.4	6.3	1.17
7/16	14	7.4	6.3	1.17
7/23	41	7.1	6.0	1.18

mentous algae (principally *Tribonema bombycinium*) appeared. Within these masses the clams moved in large numbers. By the end of the 8th week, after the water temperature had ranged between 12-14° C for 3 weeks, the algal masses began to disintegrate. The clams, however, continued to grow rapidly until the 14th week, when the water temperature was suddenly elevated to 24°C, and at the same time the production of young sphaeriids began. The growth of adults then continued at a much slower rate.

The mean length, mean height, and length-height ratio for each collection is given in Table I. From the mean lengths of animals in this series of samples a growth curve for the natural population was constructed (Figure 3). The mean length at death was 7.4 mm and the maximum length 9.2 mm.

The ratios of mean length to mean height show the same gen-

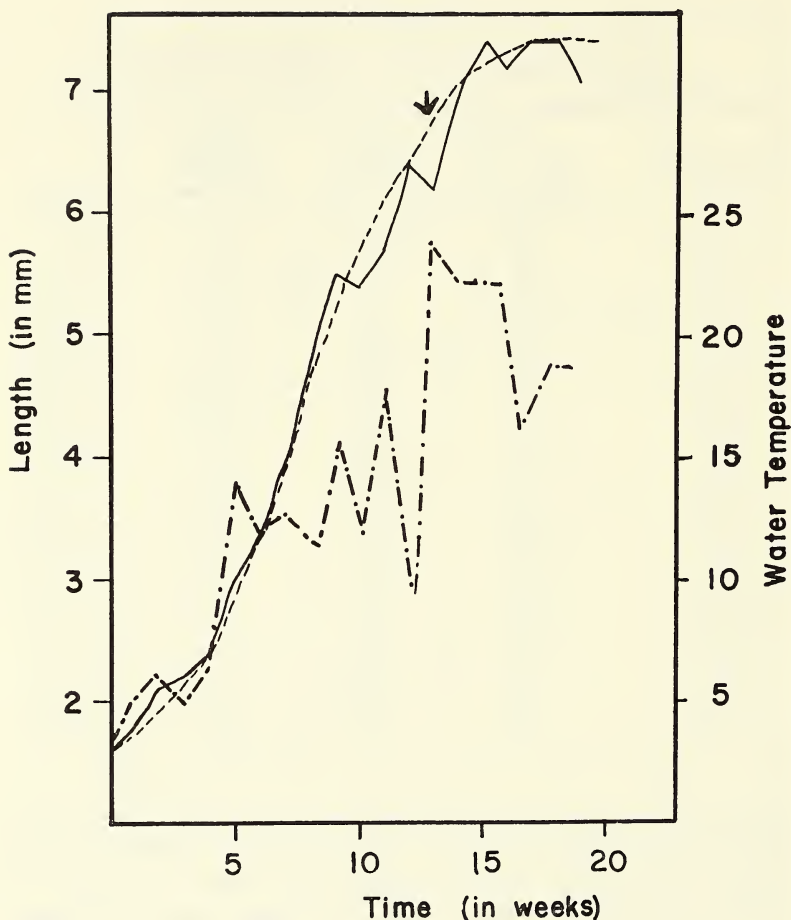


Figure 3. Growth curves for field population using mean of shell lengths for clams of weekly collections. Also included are water temperatures for the same period, and an arrow indicating the point at which young began to appear.

- growth curve based on actual means
- - - growth curve constructed by inspection
- . — water temperatures

eral trend as in the laboratory specimens. However, up until the 15th week the animals in the field stock are markedly more elongated than laboratory specimens of the same age and length. (Figure 4). This difference, which is statistically significant was observed in the course of the study long before enough data had

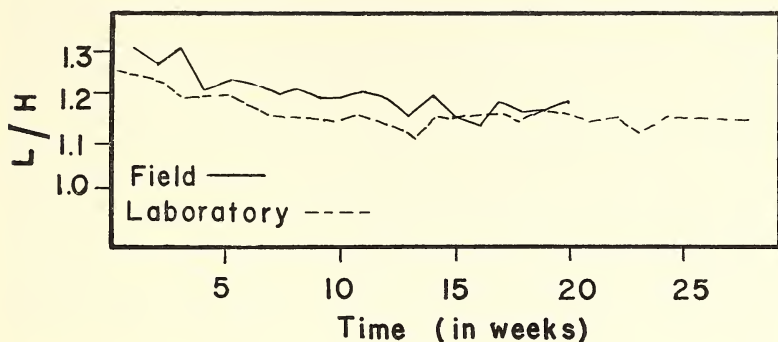


Figure 4. L/H ratios for field and laboratory animals showing a significant difference until the 15th week.

been collected for calculations of the ratios.

Discussion. It appears that under optimal conditions the clams can attain almost full size in seven to ten weeks, and can produce young before the fourteenth week after growth begins. This is of the utmost importance to an organism living in an environment when the water level is as uncertain as in vernal pond. Presumably the individuals that show no lag at the beginning have a selective advantage over others in such a habitat.

The relationship of water temperature to growth in the natural situation is probably related to the growth of food organisms. The fact that shedding of young coincided with a sudden drastic increase in water temperature may or may not be significant. Probably, however, availability of food is responsible for the greater size of clams in the field population. Possibly the food supply in the laboratory cultures was adequate for life and reproduction, but not sufficient to support maximum growth. The ciliated protozoans which inhibited growth in laboratory cultures are obviously competitors for that food.

The difference in L/H ratios in field and laboratory populations is interesting. There is a possibility it is an ecological effect, but there is also a possibility it is genetic since the laboratory animals were produced by self-fertilization from a small number of clams originally brought in from the field (Thomas 1959). This observed difference is a somewhat exaggerated example of the variability exhibited by clams of the same species but from different habitats.

It is significant that of the 50 "adults" reared in laboratory cultures only two were from aerated dishes. All the other specimens in such dishes died or grew only slightly. Whether the deleterious effect of aeration was due to mechanical disturbance by the jet, or poor bacterial (food) growth is not known. Obviously the oxygen requirements of the clams are not great since sufficient oxygen can diffuse from the surface of the culture dish. This also is not surprising in view of foul conditions found late in the growing season in the bottom of the pond, or under ice during years when the pond has standing water all winter. (Kenk, 1947).

SUMMARY

1. Most of the growth of *Sphaerium (Musculium) partumeium* (Say) can be accomplished in 7-10 weeks.
2. Young can be produced before the 14th week of growth.
3. Size of clams grown in the field is greater than that of laboratory specimens in this case (possibly because of a richer food supply).
4. L/H ratios of field animals were different from those of laboratory animals.
5. Oxygen is not a limiting factor in the growth of these animals.

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NOTE ON LIMA (ACESTA) ANGOLENSIS

BY KENNETH J. BOSS

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Fifteen specimens of *Lima (Acesta) angolensis* Adam and Knudsen were trawled by the U. S. Bureau of Commercial Fisheries vessel *Geronimo* on 9 September, 1963, while participating in the *Equalant II* program. All specimens were taken alive in a depth of 951 meters at *Geronimo* Station 249, 04°40'S and 11°00'E, about 55 miles west of Pointe Noire, Congo Republic (Brazzaville). Neither the bottom type nor any hydrographic data were

recorded. The original description of *angolensis* (Adam and Knudsen, 1955) was based on the holotype, which was collected by the Belgian Oceanographic Expedition (1948-1949) at Station 88, 10°45'S, 13°07'E, about 40 miles west of Ponta do Môro, Angola, in 400-500 meters. The *Geronimo* specimens constitute the second known occurrence of the species, increase the bathymetric range 450 meters, extend the geographic range about 360 miles northward, and add significant information on its biology.

Adam and Knudsen (1955) pointed out that *angolensis* is closely related to *Lima (Acesta) excavata* (Fabricius), an eastern north Atlantic species which ranges from Norway to the Azores in depths of 150-1450 fathoms (Thiele, 1918; Vokes, 1963a). In comparing *excavata* with *angolensis*, Adam and Knudsen noted the differences of the shape of the auricles, the size of the lunule, the strength of the ridges which define the lunule, and the development of the rudimentary lateral teeth. This latter trait was described:

"Le plateau cardinal de la valve droite présente à chaque extrémité un nodule; dans la valve gauche il y a aux endroits correspondants de chaque côté deux nodules allongés et parallèles. Ces nodules sont tous très peu apparents."

Dall (1902) documented the occurrence of lateral teeth in *Lima (Acesta) goliath* Sowerby and *Lima (Acesta) patagonica* Dall, and he mentioned that *excavata* lacked lateral teeth. A comparison of *excavata* from Hardanger Fjord, Norway, with *angolensis* shows that distal marginal irregularities, which could be considered obsolete lateral dental elements, occur in both species, rendering this character diagnostically unsuitable.

Other morphological characters, including conchological measurements, afford further specific parameters which may define the species. Table 1 gives some measurements of *angolensis* and *excavata*. The mean height/length ratio of *angolensis* is less than that of *excavata* but the overlap is considerable. More important are the ratios, breadth/height and breadth/length; both of them indicate that *excavata* has a greater lateral expansion. In these ratios, the amount of overlap is small. As pointed out by Vokes (1963b), the posterior auricle of *angolensis* is shorter than that of *excavata*, giving the outline of the shell a more broadly rounded posterior dorsal margin. Further, in *angolensis* the

	Height	Length	Breadth	Height/length	Breadth/height	Breadth/length
<u><i>angolensis</i></u>						
holotype	153	122	49	1.30	0.32	0.40
1	164	127	59	1.30	0.40	0.50
2	162	123	62	1.31	0.40	0.50
3	159	120	66	1.32	0.41	0.60
4	159	119	50	1.33	0.31	0.42
5	156	137	58	1.13	0.40	0.42
6	154	117	59	1.31	0.40	0.50
7	152	116	59	1.31	0.40	0.50
8	148	113	57	1.30	0.40	0.50
9	142	111	57	1.30	0.40	0.51
10	139	114	51	1.21	0.40	0.48
11	133	103	49	1.30	0.40	0.50
12	130	104	44	1.30	0.33	0.42
13	123	103	48	1.20	0.40	0.50
14	105	81	31	1.30	0.30	0.40
mean				1.28	0.38	0.47
<u><i>excavata</i></u>						
1	135	101	62	1.33	0.50	0.61
2	122	92	60	1.32	0.50	0.70
3	121	89	48	1.40	0.40	0.53
4	115	86	46	1.33	0.40	0.53
5	106	81	42	1.30	0.40	0.51
6	105	82	52	1.30	0.50	0.63
7	104	80	46	1.30	0.44	0.60
8	103	76	39	1.40	0.40	0.51
9	91	65	35	1.40	0.40	0.53
10	80	71	39	1.30	0.43	0.54
11	88	64	35	1.40	0.40	0.54
mean				1.34	0.43	0.56

Table I. Measurements in millimeters of *Lima (Acesta) angolensis* and *L. (A.) excavata*. Holotype data from original description; specimens of *angolensis* from Geronimo Station 249; those of *excavata* from Hardanger Fjord, Norway, in the collection of the U. S. National Museum.

anteroventral ridges which define the periphery of the lunule are stronger and more angular than the less definitive ridges in *excavata*. An internal view of the shell shows that the margin of the lunule of *angolensis* is more concave and lacks the strong proximal lunular notch of *excavata*. The radial sculpture is stronger and more widely spaced in *excavata*, perhaps a reflection of its heavier and thicker shell. The sculpture of *angolensis* is less well developed and finer, and the shell itself is thin and rather fragile.

Some epizoic commensal organisms were observed in association with *angolensis*. Two living specimens of a species of the prosobranch gastropod *Capulus*, here tentatively referred to as *C. ungaricus* (Linnaeus), were found attached to *angolensis* in

the region of the margin of the lunule. The site of attachment on one specimen is about 30 millimeters in diameter and is impressed in the shell, forming a scar. Four of the limas exhibited these deformations of the shell, three on the right valves and one on the left. The left valve of the holotype of *angolensis* also possesses a similar disfiguration near the lunular margin. In one of the *Geronimo* specimens, an elongate hole was bored through the shell by *Capulus*. The snail lives with its apex directed away from the edge of the shell of its host, a condition similar to that exhibited by *Capulus ungaricus* on *Chlamys opercularis* (Linnaeus) in Europe (Sharman, 1956).

At least 6 of the specimens of *angolensis* have small, circular depressions which measure from one to three millimeters in diameter, distributed on the surface of the valves. These depressions are occupied by a species of the foraminiferan genus *Rosalina*. A complete penetration of the limid's shell may be effected in these depressions, and the mantle of the mollusk may secrete a conical deposit on the internal surface of the valve in a reaction against the irritation caused by the *Rosalina*. Other foraminiferan species of the genera *Cibicides* and *Placopsilina* may be attached to the shell externally.

The soft parts of all the specimens were preserved. None of them possessed a byssus; however, these limas may possibly attach byssally in the immature stage. The posterior pedal-byssal retractor muscle is small and inserts in the muscular portion of a special axial branchial apparatus which irregularly attaches to the shell posteroventral to the strong adductor muscle.

Acknowledgments. The specimens of *angolensis* were transmitted to the U. S. National Museum by Dr. J. Lockwood Chamberlin of the Bureau of Commercial Fisheries Biological Laboratory, Washington, D. C. Dr. Ruth Todd of the U. S. Geological Survey, Washington, D. C., identified the genera of Foraminifera.

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MOLLUSKS NEW TO SOUTH CAROLINA

BY ARTHUR S. MERRILL¹ AND RICHARD E. PETIT²

Certain species collected in beach drift along the shores of South Carolina, and other material brought to us by cooperating shrimp fishermen in the past, led us to suspect that many of the mollusks from the Caribbean province inhabit these waters but have never been reported in the literature due to the lack of concentrated collecting. Therefore, we decided to do extensive shore collecting and offshore dredging when possible, in an effort to define properly the fauna. This work has resulted in many range extensions to South Carolina, some of which are here reported.

Many of our range extensions are major ones, commonly extending known ranges northward from southeast Florida, over four hundred miles. These records from South Carolina are particularly important because this state lies between Cape Hatteras and southern Florida, areas where the molluscan fauna has been much more extensively defined. One has only to check the "specimens examined" sections of *Johnsonia* to realize the lack of specific locations for species between these areas. Most of the North Carolina records are from the old *Albatross* dredgings, and those from southern Florida are largely from the McGinty dredgings. Until our recent work, little dredging has been done off the South Carolina coast since the *Albatross* made a few deep water stations in 1885.

We are fortunate to have dredgings from 18 stations offshore to supplement our shore collecting. Our first series of dredgings consisted of a transect of 12 stations off McClellanville, S. C. made in July 1963 aboard the shrimp boat, *Miss Kim*, at depths

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of 1 to 64 meters. Another transect of six stations off Cape Romain, S. C. followed in November 1963 using the Woods Hole Oceanographic Institution R/V *Gosnold* at depths of 36 to 268 meters. A 30-inch Digby scallop dredge, lined with $\frac{1}{2}$ inch mesh, was towed at all stations.

This paper is the first of several in which we will report range extensions to South Carolina. We will also reaffirm or clarify older records when this seems necessary.

In determining the distribution of the mollusks we have consulted the usual references which contain such information. These include, in all cases, Dall (1889), Mazyck (1913), Johnson (1934), Abbott (1954 and 1958), Warmke and Abbott (1961), as well as all *Johnsonia* monographs and all volumes of the *Nautilus*.

At least one collection of each species mentioned in this report has been placed in the Museum of Comparative Zoology, except when only one specimen of a species has been taken. Such specimens are being retained for the purpose of comparison until we have completed our studies, at which time they will also be deposited at the MCZ.

We acknowledge the cooperation of the Woods Hole Oceanographic Institution and Dr. K. O. Emery, geologist and chief scientist of *Gosnold* Cruise no. 33, for allowing us several hours of ship time for the purpose of dredging off Cape Romain, S. C., when the vessel was passing through these waters taking echo soundings and seismic profiles.

We are indebted to the following people for assistance in identifying or confirming identification of species within their special interests: Drs. William J. Clench, Ruth D. Turner, Kenneth J. Boss, Harold A. Rehder, Joseph P. E. Morrison, Joseph Rosewater and Alex A. Olsson.

We particularly wish to thank Drs. R. Tucker Abbott and Robert Robertson for examining some of our material and also for reviewing our manuscript.

GASTROPODA

Calliostoma (*Kombologion*) *marionae* Dall.

Calliostoma marionae Dall 1906, *Nautilus*, 19: 131.

One large fresh fragment, about two-thirds of body whorl, 21 mm. in diameter, dredged off Cape Romain, S. C. (N. Lat. 32°-

49.0'; W. Long. 78°16.3'), in 65-80 meters, on Nov. 27, 1963. Another fresh fragment dredged nearby.

Previous northernmost record, "off St. Augustine, Fla." (Clench and Turner, 1960, p. 51).

Turritella exoleta (Linnaeus)

Turbo exoletus Linnaeus 1758, Syst. Nat., ed. 10, p. 766.

Live adult specimens, reaching 35 mm. in length, dredged off Cape Romain, S. C. (N. Lat. 32°49.4'; W. Long. 78°16.7'), in 55 meters, on Nov. 27, 1963; also found to be common in other nearby dredgings.

Previously recorded as far north as, "south half of Florida" by Abbott (1954, p. 141).

Siliquaria squamata Blainville

Siliquaria squamata Blainville 1827, Dict. Sci. Nat., 49: 213.

One fresh dead specimen, about 90 mm. in length, dredged off Cape Romain, S. C. (N. Lat. 32°49.4'; W. Long. 78°16.7'), in 55 meters, on Nov. 27, 1963. Also, a smaller dead specimen from a nearby station.

Northernmost range previously reported, off Palm Beach, Fla. (McGinty and McGinty, 1957, p. 39). Bathymetric range also extended, being previously reported from 80-163 fathoms [ca. 150-300 meters] (Johnson, 1934, p. 105).

Epitonium (Asperiscala) apiculatum (Dall)

Scala apiculata Dall 1889, Bull. Mus. Comp. Zool., 18: 310.

Four adult specimens, largest measuring 10 mm. in height, collected in beach drift at low tide at Ocean Drive Beach, S. C., in Feb. 1960. Also, one small broken shell dredged off Cape Romain, S. C., Nov. 27, 1963, in 46 meters.

Clench and Turner (1952, p. 292) remark that this species is, "known only from North Carolina." However, their *Albatross* station 2619 record is in fact due east of a point about 5 miles south of Myrtle Beach, S. C. Our record from Cape Romain is a minor range extension; our primary purpose here is to point out that this species reaches a much larger size (over twice as large) than has been reported, and to correct the impression that North Carolina is as far south as it ranges.

It might be well to point out at this time that we have collected *Epitonium (Asperiscala) championi* Clench and Turner at Myrtle Beach, S. C. which Clench and Turner also report as ranging

south to North Carolina, although their Frying Pan Shoals record is probably well into the latitude of South Carolina.

Epitonium (Epitonium) krebsii (Mörch)

Scala krebsii Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn No. 17, p. 252.

One fresh dead specimen, 10.6 mm. in length, dredged off Cape Romain, S. C. (N. Lat. $32^{\circ}43.2'$; W. Long. $78^{\circ}09.7'$), in 176 meters, on Nov. 27, 1963.

Previous northernmost record, "off Palm Beach, Fla." (Clench and Turner, 1951, p. 258).

Crucibulum auricula (Gmelin)

Patella auricula Gmelin 1791, Syst. Nat., ed. 13, p. 3694.

One fresh dead specimen, 18 mm. in greatest diameter, dredged off McClellanville, S. C. (N. Lat. $32^{\circ}42.4'$; W. Long. $79^{\circ}06.2'$), in 27 meters, on July 2, 1963.

The most northern record listed by most authors is "West Florida," probably as a result of Dall's (1889, p. 152) specific designation of Cedar Keys, Fla. as northern extreme range.

Tugurium (Tugurium) caribaeum (Petit de la Saussaye)

Xenophora caribaea Petit de la Saussaye 1856, Journ. de Conchyl., 5: 248, pl. 10, fig. 1-2.

One fresh dead adult specimen, 64 mm. in greatest diameter, dredged off Cape Romain, S. C. (N. Lat. $32^{\circ}43.2'$; W. Long. $78^{\circ}09.7'$), in 176 meters, on Nov. 27, 1963.

Previously recorded from the Florida Keys by Johnson (1934, p. 96) and others, but not recorded from the mainland of the United States by Clench and Aguayo (1943, p. 5). However, they did remark that Dall (1889) considered North Carolina as the northern range of this species, but noted that Dall's material apparently included specimens of *T. longleyi* Bartsch, and for that reason they limited the northern range to Cuba. Also reported from off Palm Beach, Fla. (McGinty and McGinty, 1957, p. 40).

Sigatica semisulcata (Gray)

Natica semisulcata Gray, 1839 [in] Beechey, The Zool. of Capt. Beechey's Voyage, p. 136.

Two fresh dead adult shells collected on beach at Ocean Drive Beach, S. C., and one additional specimen inhabited by hermit crab found in old net brought up from 7 meters off Ocean Drive

Beach, S. C.; all collected in the fall of 1959.

Previous northernmost record, Jupiter Inlet, Fla. (Dall, 1889, p. 154).

Cypraea spurca acicularis Gmelin

Cypraea acicularis Gmelin 1791, Syst. Nat., ed. 13, p. 3421.

Several fresh dead to moderately worn adult specimens dredged off Cape Romain, S. C. (N. Lat. $32^{\circ}49.4'$; W. Long. $78^{\circ}16.7'$), in 55 meters, on Nov. 27, 1963; also taken commonly in other nearby dredgings, some badly worn.

Previously recorded as far north as "south half of Florida" by Abbott (1954, p. 180).

Cymatium (Septa) pileare Linnaeus

Murex pileare Linnaeus 1758, Syst. Nat., ed. 10, p. 749.

One fragment of body whorl and outer lip dredged off Cape Romain, S. C. (N. Lat. $32^{\circ}49.1'$; W. Long. $78^{\circ}16.3'$), in 65-80 meters, on Nov. 27, 1963.

Johnson (1934, p. 114) lists the range of this species in the western Atlantic as, "Florida Keys and the West Indies." Abbott (1954, p. 195) extends the range to North Carolina, but Clench and Turner (1957, p. 218) in the latest monograph to include this species shows northernmost record only to Jupiter Inlet, Fla. *Cymatium (Septa) krebssii* (Mörch)

Triton krebssii Mörch 1877, Malakozoologische Blätter, 24: 30.

One fresh dead specimen, 27 mm. in length, dredged off Cape Romain, S. C. (N. Lat. $32^{\circ}49.4'$; W. Long. $78^{\circ}16.7'$), in 55 meters, on Nov. 27, 1963.

Previous northernmost range, "off Delray Beach, Fla." (Clench and Turner, 1957, p. 221).

Cymatium (Monoplex) parthenopeum (von Salis)

Murex parthenopeus von Salis 1793, Reisen in versch. Prov. Königreich Neapel, 1: 370, pl. 7, fig. 4.

One live specimen, 93 mm. in length, taken by trawler *Miss Key*, 40 miles off McClellanville, S. C., in 75 meters, in June 1962.

Previous northernmost range in western Atlantic: U. S. coast, "south end of Lake Worth, Fla."; Bermuda (Clench and Turner, 1957, p. 230).

Cymatium (Linatella) poulsenii (Mörch)

Triton (Linatella) poulsenii Mörch 1877, Malakozoologische Blätter, 24: 33.

One fresh dead specimen, plus several fragments, dredged off McClellanville, S. C. (N. Lat. $32^{\circ}31.2'$; W. Long. $78^{\circ}51.0'$), in 46 meters, on July 3, 1963.

Previous northernmost range, "off Palm Beach, Fla." (Clench and Turner, 1957, p. 200).

To complete the list of species of the genus *Cymatium* now known from South Carolina we include the following: A juvenile, *Cymatium (Ranularia) caribbaeum* Clench & Turner 1957, was collected alive from a navigation buoy located off Port Royal, S. C. (Merrill, 1962). A juvenile, *Cymatium (Cabestana) labiosum* (Wood) 1828 was also taken from a navigation buoy from off Cape Romain, S. C., by the senior author in 1948. This record appears in the monograph by Clench & Turner (1957) on page 222. We have taken *labiosum* from off Cape Romain in our recent dredgings.

Bursa thomae (Orbigny)

Ranella thomae Orbigny 1842 [in Sagra], Hist. l'Ile Cuba, 2: 164, Atlas, pl. 23, figs. 23, 24.

One live 20 mm. adult dredged off Cape Romain, S. C. (N. Lat. $32^{\circ}43.2'$; W. Long. $78^{\circ}09.7'$), in 176 meters, on Nov. 27, 1963.

Previous northernmost record from Western Atlantic, off Palm Beach, Fla. (Abbott, 1958, p. 57).

Murex cabritii Bernardi

Murex cabritii Bernardi 1859 ("1858"), Journ. de Conchyl., 7: 301, pl. 10, fig. 3.

A fresh fragment of a large shell, dredged off McClellanville, S. C. (N. Lat. $32^{\circ}31.2'$; W. Long. $78^{\circ}51.0'$), in 46 meters, on July 3, 1963.

Dall (1889) lists this species as occurring north to Cape Hatteras, N. C. However, Johnson (1934) gives northernmost range as Cedar Keys, Fla., and Clench and Farfante (1945, p. 5) show Pompano, Fla., for their northernmost record. Abbott (1954) also restricts the range to Florida.

Murex rubidus F. C. Baker

Murex messorius var. *rubidum* 'Dall' F. C. Baker 1897, Trans. Acad. Sci. St. Louis, 7 (16): 377.

One medium-sized live specimen, 30 mm. in length, dredged off Cape Romain, S. C. (N. Lat. $32^{\circ}49.4'$; W. Lat. $78^{\circ}16.7'$), in 55 meters, on Nov. 27, 1963.

Previous northernmost record, Lake Worth, Fla. (Clench and Farfante, 1945, p. 9).

Pterynotus pygmaeus Bush

Murex (Pteronotus) pygmaeus Bush 1893, Bull. Mus. Comp. Zool., 23: 213, pl. 1, figs. 3-4.

One specimen, 14.4 mm. in length, dredged off Cape Romain, S. C. (N. Lat. $32^{\circ}43.2'$; W. Long. $78^{\circ}09.7'$), in 176 meters, on Nov. 27, 1963.

Previously known only from the holotype which was dredged from Blake Station 319, off Charleston, S. C. (N. Lat. $32^{\circ}25'$; W. Long. $77^{\circ}42'30''$), in 262 fathoms [480 meters].

Drupa (Morula) nodulosa (C. B. Adams)

Purpura nodulosa C. B. Adams, 1845, Proc. Boston Soc. Nat. Hist., 2: 2-3.

Two live specimens, dredged off McClellanville, S. C. (N. Lat. $32^{\circ}31.2'$; W. Long. $78^{\circ}51.0'$), in 46 meters, on July 3, 1963.

Previous northernmost record, "Biscayne Bay, Fla." (Abbott, 1958, p. 63).

Coralliophila aberrans (C. B. Adams)

Purpura aberrans C. B. Adams, 1850, Contrib. to Conch., No. 4, pp. 58-59.

One very fresh, 9.4 mm. specimen, dredged off Cape Romain, S. C. (N. Lat. $32^{\circ}43.2'$; W. Long. $78^{\circ}09.7'$), in 176 meters, on Nov. 27, 1963.

Previous northernmost range, "West Indies" (Warmke and Abbott, 1961, p. 109).

Coralliophila caribaea Abbott

Coralliophila caribaea Abbott 1958, Acad. Nat. Sci. Philadelphia, Monograph 11, pp. 66, 68.

Three live specimens, largest measuring 15 mm. dredged off McClellanville, S. C. (N. Lat. $32^{\circ}31.2'$; W. Long. $78^{\circ}51.0'$), in 46 meters, on July 3, 1963.

Previous northernmost record, off Palm Beach, Fla. (Abbott, 1958, p. 67).

Hyalina (Volvarina) veliei (Pilsbry)

Marginella veliei Pilsbry 1896, Proc. Acad. Nat. Sci. Philadelphia, 71: 206.

One medium-sized live specimen dredged off McClellanville, S. C. (N. Lat. $32^{\circ}31.2'$; W. Long. $78^{\circ}51.0'$) in 46 meters, on

July 3, 1963. Two fresh fragments also found in dredgings nearby.

Abbott (1954, p. 258) gave range as west coast of Florida, common in shallow water; Johnson (1934, p. 132) restricted it to Boca Ciega Bay, Fla.

In the specimens we collected the color of the shell is reddish brown on the dorsal surface. In specimens we have seen from shallow water off west Florida, the shell is uniformly yellow. On the other hand, dredged specimens from the deeper waters of west Florida are a uniform white color and are smaller than ones from shallow water.

Pyrgocythara coxi Fargo

Pyrgocythara coxi Fargo, 1953 [in] Pliocene Mollusca of southern Florida, Acad. Nat. Sci. Philadelphia, Monograph No. 8, pt. 2, p. 384, pl. 20, figs. 3, 3a.

Two adult specimens about 8 mm. in length, inhabited by hermit crabs, found in seaweed washed ashore at Ocean Drive Beach, S. C., on Feb. 12, 1960. A third specimen was obtained from a tide pool at Myrtle Beach, S. C., about a year later.

This species was described from the Pliocene of St. Petersburg, Fla., but was also noted at the same time as having been found Recent nearby. Range extensions have appeared twice in the literature in the few years since this small species was described. Abbott (1958, p. 97) reported it from Gun Bay, Grand Cayman Island, B. W. I. and Warmke and Abbott (1961, p. 138) noted its occurrence in Puerto Rico. The occurrence of this species as a Neogene fossil in South Carolina will be reported later.

Sayella crosseana Dall

Sayella crosseana Dall 1885, Proc. U. S. Natl. Mus., 8 (18): 286, pl. 18, fig. 10.

One specimen, 4.3 mm. in length, inhabited by hermit crab, found in seaweed washed on shore at Ocean Drive Beach, S. C., on Feb. 12, 1960.

Previous northernmost record, Matecumbe Key, Fla. (Henderson, 1913, p. 59).

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NOTE ON *ELLIPTIO SPINOSA* IN GEORGIA

BY GRACE J. THOMAS AND DONALD C. SCOTT

University of Georgia

Numerous specimens of *Elliptio spinosa* (Lea) have been collected in recent years from the Altamaha River at Fort Barrington, Long County, Georgia (Tomkins, 1955). We are reporting the extension of the known range to Jessup on the Altamaha River, and into the Ocmulgee River at Jacksonville, Telfair County, and Red Bluff on the Ben Hill-Coffee County line.

All our collections were made from the protected sides of sand bars in the river, and include both living animals and shells. Living specimens ranged from 4.2 mm. to 9.4 mm. in length. Six

other species of unionids were associated with *Elliptio spinosus* at one or more stations (Table I).

Table I.

(An X indicates the presence of the species in collections at the given locality.)

Species	Stations		
	Jessup	Red Bluff	Jacksonville
<i>Alasmidonta arcua</i> (Lea)	X		X
<i>Anodonta gibbosa</i> Say	X		
<i>Elliptio hopetonensis</i> (Lea)	X	X	X
<i>Elliptio shepardianus</i> (Lea)			X
<i>Elliptio spinosa</i> (Lea)	X	X	X
<i>Lampsilis dolabraeformis</i> (Lea)	X	X	X
<i>Lampsilis splendida</i> (Lea)	X		X

The species represented by the largest number at every station is *Lampsilis dolabraeformis*. At Jacksonville *Elliptio hopetonensis* and *Lampsilis splendida* also occur in large numbers. *Alasmidonta arcua*, on the other hand, is represented in the collections by a single specimen.

It is interesting to note that these 3 species of *Elliptio*, the 2 of *Lampsilis*, and *Alasmidonta arcua* were described by Lea from shells collected on the lower Altamaha River near Darien. (Lea, 1834, 1838). In view of the fact that these species occur in the Ocmulgee River we must next discover whether they are also to be found in the lower portion of the Oconee River, the other major Altamaha tributary.

The authors wish to express thanks to Ivan R. Tomkins for specimens from Fort Barrington, and to Milton Hopkins II, Milton Hopkins III and Heyward Mathews for collections on the Ocmulgee.

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AMERICAN MALACOLOGICAL UNION THIRTY-FIRST ANNUAL MEETING

The isolation of Wagner College upon a Staten Island, New York, hilltop was no surprise to those who attended the 1955 meeting. Little had changed save for the mighty Verrazano Narrows bridge visible in the distance and the new dormitories and students' union building added to the campus. As before, the New York Shell Club acted as host; its busy members seemed to be everywhere at once, while they ministered to the comfort and convenience of the visitors.

Over the four day period, July 20 to 23, 1965, President Juan J. Parodiz introduced the following papers:

Some inland mollusk records from Nicaragua, M. K. Jacobson. Small beginnings, A. B. Wheel. The surf clam fishery, Arthur E. Merrill. The families of Turridae, J. P. E. Morrison. Sculptural traits in the Tellinacea, Kenneth J. Boss. Coelenterate-associated prosobranchs in the Indian Ocean, Robert Robertson. Starch-gel electrophoresis in oyster sera, A. Rosenfield and C. Sindermann. Results of deep-water testing, Ruth D. Turner. Bacterial epizootics of larval and juvenile pelecypods, H. Tubiash. The naiad fauna of the Green River of Mundfordville, Kentucky, David H. Stansbury. Cytological studies in Stylommatophora, Rajagopala Natarajan. Sexual dimorphism in the radula of *Nassa*, Virginia O. Maes. Deep water oysters from the lower Patuxent River, Maryland, Kenneth Boss and Arthur Merrill. Re-examination of E. S. Morse's study in changes in the shells of *Mya arenaria*, Ralph W. Dexter. Studying living Tridacnidae in the Marshall Islands, Joseph Rosewater. The story of the MSX, outbreaks and oyster mortality in Delaware Bay, H. Haskin. Studies on captive *Prunum apicinum* Menke, Dorothy Raeihle. The naiad fauna in the Little Darby Creek in central Ohio, Carol B. Stein. Pathologic responses of the oyster *Crassostrea virginica* to infection by the protistan parasite MSX., A. Farley. Biological significance of aerial sea surface temperature surveys, R. B. Stone. Ecology of *Tarebia granifera* and *Melanoides tuberculata* in south Texas, Harold D. Murray. Pink sands of Eleuthera, Dorothy and Norman Jensen. Camera close-ups of live mollusks, George Raeihle. Malacological musings, James E. Wadsworth. Maintenance of

oyster tissue in vitro, A. Rosenfield. The genus *Cucullaea* (Pelecypoda), past and present, Katherine V. W. Palmer. Electrophoretic studies of some diploid and polyploid *Bulinidae*, G. L. Place. On the genera of *Hipponycidae*, J. P. E. Morrison. Marshland is not wasteland; film presentation of the Staten Island Institute of Arts and Sciences. The Marquis de Folin and his work on the *Caecidae*, Donald R. Moore. Late Cenozoic evolution of the *Aequipecten gibbus* stock, Theodore R. Waller. South American malacology, Dee Dundee. Enzyme histochemistry of the American oyster, *Crassostrea virginica*, A. F. Eble. Freshwater and land snails of St. Lucia, West Indies, Emile A. Malek.

The invitation of the North Carolina Shell Club to hold the 1966 A.M.U. meeting in that state was accepted, exact place and date to be announced.

The following slate of officers was elected to serve during the next year:

President, Ralph W. Dexter. Vice-President, Leo G. Hertlein. Second Vice-President, Alan J. Kohn. Secretary, Margaret C. Teskey. Treasurer, Mae Dean Richard. Publications Editor, M. Karl Jacobson. Councilors-at-Large: Mary Kline, Joseph Rosewater. Robert R. Talmadge, Gordon Usticke. —MARGARET C. TESKEY, Secretary, American Malacological Union, Inc.

NOTES AND NEWS

OTALA LACTEA FROM TIERRA VERDE FLORIDA — On October 24, 1964, 7 living specimens of *Otala lactea* (Müller) were collected on the island of Tierra Verde, Florida (on the former Cabbage Key in a region on the gulf side of the Pinellas Bayway about 1.3 mi. from the bridge at the north end of the island). They were found under boards in an area where construction materials were piled; however, numerous empty shells were also observed and collected in the surrounding brushy areas. (The authors are grateful to R. Tucker Abbott for verifying the identification on these shells and to G. E. Woolfenden for a previously collected living specimen indicating their presence in this area.) Since the region was extremely dry at the time, and the majority of the living snails presumably were secreted in protected places, no impression of the size of the population was obtained.

Although the presence of *Otala* on Cabbage Key has been known for some time (Henderson, 1937, *Nautilus* 50: 72; Van Der Schalie, 1938, *Nautilus* 51: 132-34), it was considered important by the authors to update the record since the area involved has been undergoing intensive development. Of additional interest was the existence in the sample of what appears to be a number of phases of shell pigmentation. These phases ranged from a complete absence of line and aperture coloration through at least one intermediate group, to individuals exhibiting dark, chocolate-brown lines and apertures. The animals of the first group, although lighter, did not appear to be completely devoid of body color; however, their shells were grossly unpigmented even though textural evidence of line markings could be observed. —FRANK E. FRIEDL and RONALD A. BAYNE, Department of Zoology, The University of South Florida, Tampa 33620.

TWO NEW LAND MOLLUSK RECORDS FROM FLORIDA. — During the course of an investigation of the land mollusks of northwestern Florida, two species were found that do not appear to have been previously recorded from this state.

Mesomphix pilsbryi (Clapp) was found to be quite numerous 0.2 miles due south of the lodge at Florida Caverns State Park, Jackson County, Florida. It was found among moist limestone rubble along with many other land snails. This species was identified by Mr. Leslie Hubricht of Meridian, Mississippi. *Mesomphix pilsbryi* has been reported from several counties in southern Alabama by Walker (1928) and Pilsbry (1946).

Limax flavus Linnaeus was discovered at a single urban locality in Tallahassee, Leon County, Florida. It was quite common under stones and leaf litter around a residence at 208 Fifth Avenue. Numerous similar habitats have been examined in and around Tallahassee without any trace of this slug being discovered, which suggests that it is a recent immigrant to this area. This slug has previously been found as far south as southern Alabama and Georgia (Pilsbry, 1948) and its presence in northern Florida is not surprising. Tallahassee specimens are very dark for the species, almost black, with only scattered yellow spots.

Specimens of both species have been deposited at the Florida State Museum in Gainesville. —LONDON T. ROSS, Dept. of Geol-

ogy, Fla. State University, Tallahassee.

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SEXUAL DIMORPHISM IN THE RADULA OF THE MURICID GENUS *NASSA*

By VIRGINIA ORR MAES

Academy of Natural Sciences of Philadelphia

In the course of working out differences between two species, *Nassa francolina* (Bruguière, 1789) and *Nassa sertum* (Bruguière, 1789), I came upon an interesting case of sexual dimorphism in the radula. As far I know, this has been reported only once before: by Arakawa (1958), who found this phenomenon in another muricid genus, *Drupella*. Both Cooke (1919) and Peile (1937) remarked upon the variation in *Nassa* radulae but did not recognize its meaning. Hollister (1954) described a similar variation in the rachidian of the fascioliariid *Pleuroploca gigantea* but correlated this variation with the size (age) of the shell and not the sex. The similarity of this dimorphism, the increase in size of the central cusp at the expense of the lateral cusps of the rachidian in all 3 cases, leads one to the disturbing conclusion that this type of radular dimorphism may be a rather common phenomenon. Certainly it indicates the importance of keeping all pertinent data with both the radula and the shell and of basing observations on numbers of specimens of both sexes.

Before describing this dimorphism it might be well to clarify a few of the confusing taxonomic problems surrounding my material. For the two species discussed, I use the genus *Nassa* Röding, 1798, type *N. picta* = *Buccinum sertum* Bruguière (both names are referred to the same Chemnitz figures). *Iopas* H. & A. Adams, 1853, type *B. sertum*, is a synonym. This is not *Nassa* of Lamarck, 1799, which is *Nassarius* Duméril, 1806. Both Dall (1909) and Winckworth (1945) have discussed this use of the name *Nassa*.

Confusion between Bruguière's two species *Buccinum francolinum* and *sertum* is so widespread that literature records on the distribution of the two species are usually worthless. Peile (1937) incorrectly called *francolina*, the Indian Ocean species, "*sertum*" and others have incorrectly called *sertum* "*francolina*."

Many authors, including Cooke (1919) have believed the species synonyms. As mentioned above, *Nassa francolina* (Pl. 5, f. 1 & 2), is an Indian Ocean species with a range extending from South and East Africa to Western Australia, Sumatra and the western end of Java, with the exception of Cocos - Keeling Islands. In his original description, Bruguière described the fine, continuous, spiral whitish lines by which the smoother shelled *N. francolina* can be separated from *N. sarta*. *N. sarta* (Pl. 5, f. 3-6), the Pacific Ocean and Cocos - Keeling species, usually has a rougher shell and although the spiral cords may be worn to a pale shade of brown, they are not continuous or as fine. From the Cook Islands and Hawaii to Eastern Polynesia *N. sarta* becomes smoother but all specimens lack the fine, continuous lines. Probably Reeve's figure of one of these smooth Polynesian *N. sarta* misidentified as *francolina* has been responsible for much of the confusion surrounding the identity of these two species.

As there are greater differences between the radulae of male and female *Nassa francolina* and *sarta* than there are between the two species, I will discuss the sexual dimorphism of both species first and then point to the minor specific differences.

The radulae of *Nassa francolina* and *N. sarta* usually have about one hundred rows of teeth. Thiele (1869) reported 124 rows in a specimen (probably *sarta*) from the Philippines. Peile (1937) reported 83 and 92 "developed" rows of teeth in *Nassa* from Mahe, Seychelles (probably *N. francolina*). As *Nassa* usually has a large number of nascent rows, the two reports do not indicate any marked differences between the two species. Each row consists of one right and one left single-cusped lateral tooth and a rachidian tooth with three major cusps. Peile reported that the radula of the Red Sea species *Nassa situla* (Reeve, 1846) is similar in shape and variability to "*sarta*" (*francolina*).

In studying 36 radulae of *N. sarta* and *N. francolina*, I found that sexual dimorphism is limited to the rachidian tooth. The male rachidian tooth is broader than the female (Text fig. 1) and, with a few exceptions, the breadth of the male rachidian increases relative to shell size more rapidly than that of the female. Thus in males with shells about 30 mm. in length, an average rachidian is about 0.25 mm. while the 40 mm. males average about 0.35 mm. Females of these two size groups average

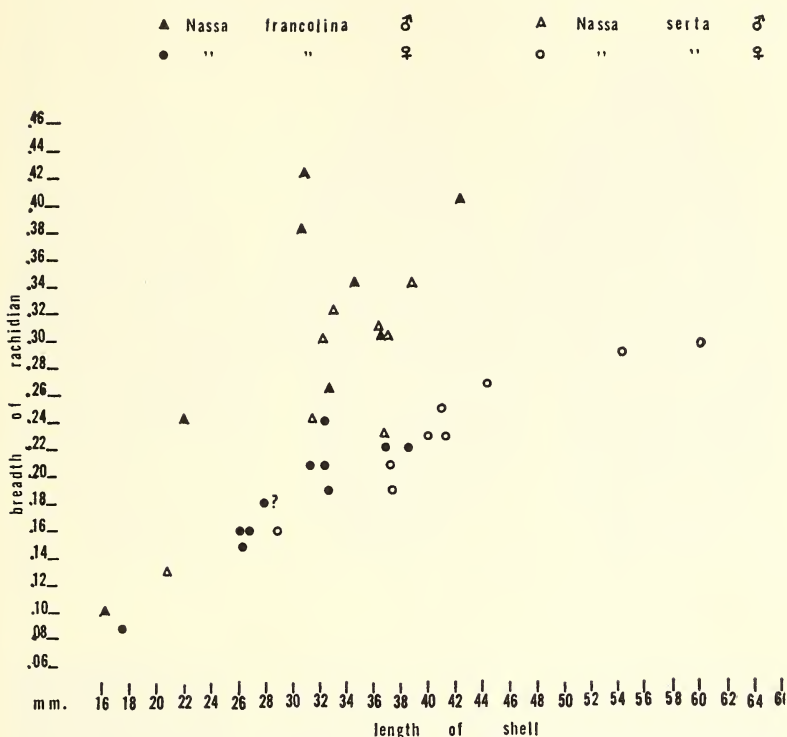


Fig. 1. Scatter diagram of the length of shells and breadth of rachidian teeth of 16 male and 20 female *Nassia* expressed in mm.

from 0.17 to 0.21 mm. respectively. The broadest male rachidian, 0.42 mm., came from a *N. francolina* 33.2 mm. in shell length and the broadest female rachidian, 0.30 mm., came from a *N. sarta* 62.4 mm. long. The breadth of the male rachidian is more variable than that of the female.

Besides a difference in size, the male rachidian becomes almost monocuspid in larger (older) specimens. The central cusp becomes longer, more erect, and massive. This is clearly seen in anterior or posterior views of single, detached teeth (Text fig. 2, figs. 1, 2, 8-10). The female rachidian, on the other hand, remains strongly tricuspid, hooked, and unthickened even in very large (old) examples. There is frequently a small denticle on either side of the central cusp of a female rachidian but this may disappear and reappear among the rows of the same radula. The

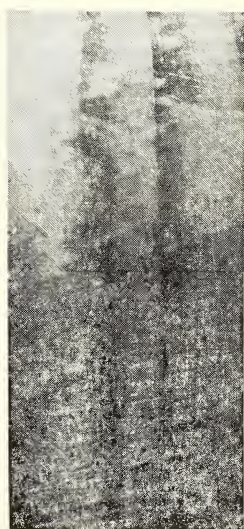
long central cusp and thickened base of the rachidian from a large male makes the preparation of a microscopic slide more difficult than that of a female. The former tends to fall on its side and flattened sections hold the cover slip high above the slide. Individual, separated rachidians fall at characteristic angles shown in Text fig. 2, figs. 3, 4, 12, and 13. Although most of the radulae are colorless, a few females as well as males are light yellow or amber. The radulae of five male *N. francolina* and two male *N. sarta* are dark brown. The color appears to be a stain rather than a coating of pigment such as found on the cusps of *Patella*. The males with brown radulae had proportionately broader rachidian teeth than those with colorless radulae.

The tendency for the male rachidian to be broader than the female is found in all size (age) groups. The pronounced enlargement of the central cusp, however, was not apparent in younger shells. The male whose radula is figured Text fig. 2, fig. 5 had a well developed penis although his shell was only 18.1 mm. long. His radula is like a female's. Some others have small inner denticles.

As for differences between the radulae of the two species, it is now apparent that comparisons can be made only between male and male and female and female. The radulae of the two species are difficult to distinguish. The lateral cusps of the female rachidian of *N. sarta* tend to be a little larger and bent. In the male, *N. sarta* tends to keep the lateral cusps longer than in *N. francolina* and the rachidian does not broaden as rapidly. This is probably because *N. sarta* is a larger species than *N. francolina* and of two shells the same size, the *N. sarta* is probably younger than *N. francolina*. Attempting to compare similar material, I tried to use radulae from shells of approximately the same size. The difficulties encountered are shown in Text fig. 1 and by the fact that in the A.N.S.P. collection the largest *N. francolina* is 54.6 mm. and the largest *N. sarta* is 69.1 mm.

I was unable to find any sexual dimorphism in the shells of *Nassa*. Possibly the females are slightly larger but the limited amount of material available makes any conclusion on a trivial difference unwise.

None of these differences is as great as those Arakawa (1958) found in *Drupella*. However, the *Nassa* radula is a simple, con-



Figs. 1, 2. *Nassa francolina* (Brug.) ANSP. 257668, Madagascar. Figs. 3, 4. *N. sarta* (Brug.) ANSP. 205730, New Guinea. Figs. 5, 6. *N. sarta*, Polynesian form, ANSP. 278464, Cook Ids. Figs. 1, 3, 5 app. 2X. Figs. 2, 4, 6 app. 10X.

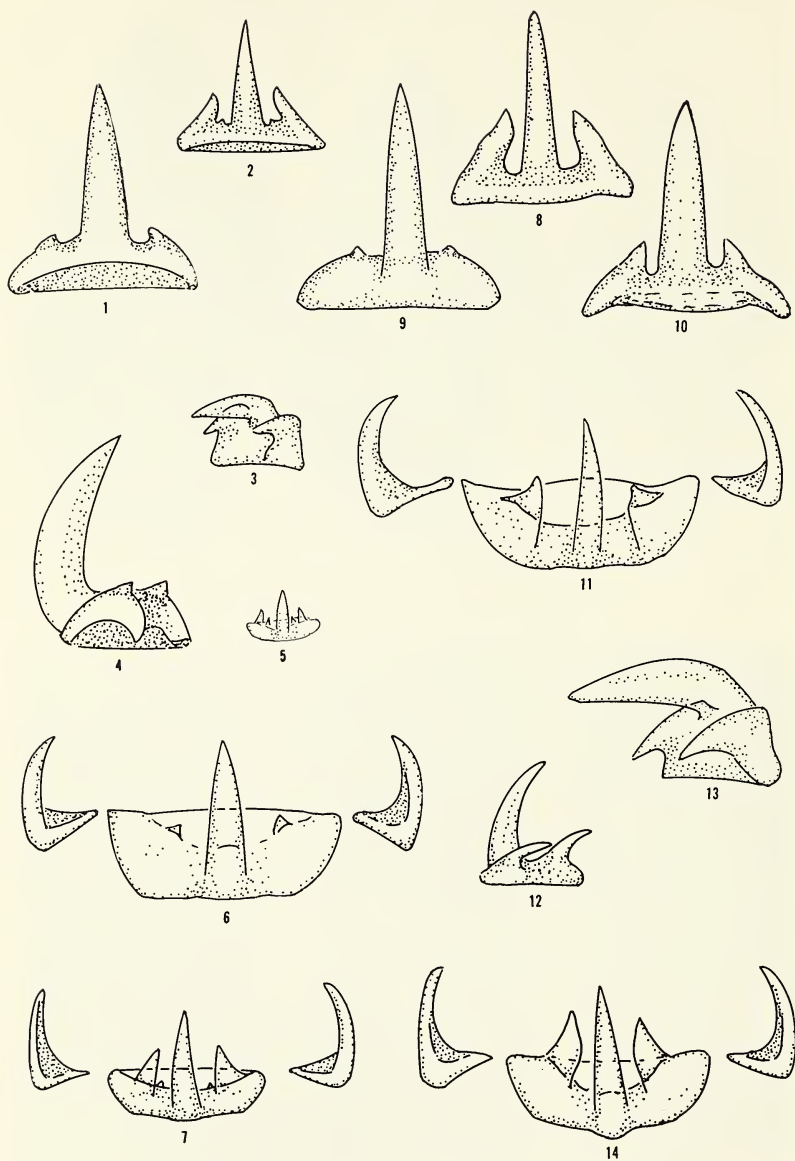


Fig. 2. Radulae of *Nassa* (all to scale X 130). 1-7. *Nassa francolina* (Brug.).
8-14. *Nassa sarta* (Brug.).

1. Male, 35.5 mm. ANSP. 257134, Madagascar. Rachidian, anterior view.
2. Female, 40.4 mm. ANSP. 213123, Zanzibar. Rachidian, anterior view.
3. Female, 33.7 mm. ANSP. 283117, East Africa. Rachidian, left side view.
4. Male, 36.8 mm. ANSP. 257668, Madagascar. Rachidian, right side view.
5. Male, yg. 18.1 mm. ANSP. 257134, Madagascar. Rachidian, dorsal view.
6. Male, 35.5 mm. ANSP. 257134, Madagascar. Row, dorsal view.
7. Female, 40.4 mm. ANSP. 213123, Zanzibar. Row, dorsal view.
8. Female, 56.3 mm. ANSP. 278007, Cook Ids. Rachidian, anterior view.
9. Male, 38.7 mm. ANSP. 205730, New Guinea. Rachidian, anterior view.
10. Male, 35.6 mm. ANSP. 202623, Palau Ids. Rachidian, anterior view.
11. Male, 41.0 mm. ANSP. 205730, New Guinea. Row, dorsal view.
12. Male, 33.9 mm. ANSP. 278007, Cook Ids. Rachidian, right side view.
13. Female, 56.3 mm. ANSP. 278007, Cook Ids. Rachidian, left side view.
14. Female, 56.3 mm. ANSP. 278007, Cook Ids. Row, dorsal view.

servative, muricid form while *Drupella* is an aberrant form with denticulate cusps on the rachidian and slender denticulate laterals. But the variations between male and female rachidians are, in essence, the same. The male *Drupella* rachidian is more massive, with a strong central cusp and smaller lateral cusps and lacks an inner denticle always found in the female. The slender lateral teeth of *Drupella* also vary, and this is not found in *Nassa*. They vary in the numbers of lateral rows to rachidian rows, i.e. there are 3 to 5 times more lateral teeth in two species of male *Drupella* than there are rachidians, while the females have an 11 to 10 ratio, i.e. almost the conservative one for one found in *Nassa*. Arakawa also found that the length of the laterals and the color of the radulae varies. The male radula is yellow and the female colorless. My brown male radulae are somewhat analogous to the latter but not as constant in character. Some decidedly male - type *Nassa* radulae are colorless.

It was not clear from Hollister's paper (1954) how much material was studied and whether his large, single - cusped rachidian came from a male or female radula. The form, though in another family, is suspiciously like the sexual dimorphism found in the two groups of muricids.

It is not possible at present to determine whether this radular dimorphism is functional. Too little is known of the habits and genetics of all species examined, but present evidence indicates it is not. Both species of *Nassa* are presumed predators living under rocks in shallow water on reefs. *Drupella* is a shallow water coralliophile but its feeding habits are not known. The late development of an aberrant radula, in male *Nassa* at least, indicates it may not be functional in mating. Several young males, with

well developed penes, found near egg-laying females, had radulae indistinguishable from female radulae except for a slightly broader rachidian.

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POSITIVE RHEOTAXIS IN GONIOBASIS PROXIMA

By PHILIP J. CRUTCHFIELD

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Introduction. Of the papers encountered on this pleurocerid snail, only Goodrich (1950), Walter (1954), and Hall (1957) make mention of upstream migration or establishment in *Goniobasis proxima* (Say). Data are presented suggesting that this upstream establishment is a rheotactic response and the degree of expression may be influenced by water temperature and water velocity.

Observations were made in a tributary of Bolin Creek north and east of Mt. Bolus, approximately one mile north of Chapel Hill, North Carolina. The sources of this creek are springs and seepages which ensure a continuous flow of water becoming much increased by surface runoff during periods of rain. The creek is characterized, in the area where the snails were encountered, by relatively steep wooded banks, shelving rock, and a rock strewn bed with gravel and coarse sand. The many pools and riffle areas indicate a relatively steep gradient.

I wish to thank Dr. J. E. Adams and Dr. C. J. Umphlett of the Botany Department and Mr. D. G. Alexander of the Zoology Department of the University of North Carolina for their critical reviews of the manuscript.

Materials and Methods. Fifty-three individuals of *G. proxima* were marked by the application of a vinyl-based paint. All

marked snails were then placed in a small eddy pool adjacent to the main creek flow. Observations were made each week for 15 weeks from 24 December 1957 to 13 April 1958. Water temperatures were recorded weekly and reported in degrees Fahrenheit. The position of the marked snails was observed, and distance traveled by each snail was measured in feet.

Observations and Results. Frequent observations of this *G. proxima* population revealed that the majority of the individuals were oriented against the current of the creek. This was most conspicuous in certain riffle areas. Furthermore it was noticed that the snails crawling upstream in these riffle areas were not uniformly distributed over the bottom, but were clustered along the outer portion of the stream flow. Many snails were dislodged by strong currents as evidenced by the appearance of large numbers of individuals in the pools located below riffle areas after rain storms. Only those snails crawling along the outer portions of the creek flow apparently were not dislodged. Individuals not oriented against the current were found to be in areas where little or no current existed.

A much higher number of marked snails was found during each sampling period above or adjacent to the eddy pool, than below it (Table 1). Over the 15 week period approximately three times as many marked snails were encountered above the eddy pool as below it, 75 and 28 respectively.

The number of marked snails encountered over the 15 week period declined rather steadily from 37 snails the first week to 5 snails the last week. The rapid decline in the total number of marked snails between the first and third weeks is attributed to rains occurring between those sample dates. The continual decline in the total number of snails during the course of the sample period is thought also to have resulted from subsequent periods of rain.

Other contributing factors accounting for the non response portion of the sample, in addition to the total removal of marked individuals, are high water levels, high turbidities, and snails crawling beneath rocks and debris. This is apparent from a perusal of table 1 where it is seen that on the third and fourth weeks 15 and 12 snails respectively were encountered. This high a recovery was not again duplicated until the eighth week when 13

Table 1 Comparison of total number of marked snails encountered each week with total number of snails above, at or below the eddy pool.

Weekly checks:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total number encountered	37	29	15	12	*	4	9	13	3	9	7	9	*	*	5
Total number above	10	7	7	9	*	4	6	8	3	6	2	8	*	*	5
Total number below	3	2	6	0	*	0	3	5	0	3	5	1	*	*	0
Total number adjacent to or in eddy pool	24	20	2	3	*	0	0	0	0	0	0	0	*	*	0

* indicates no sample taken

Table 2 Comparison of the number of marked snails observed each week with the distances from the point where all marked snails originally were placed and also compared with water temperatures.

Sampling dates:	24	4	11	18	28	9	14	21	1	7	16	23	13
	Dec	Jan	Jan	Jan	Jan	Feb	Feb	Feb	Mar	Mar	Mar	Mar	Mar
	(1)	(2)	(3)	(4)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(15)	(15)
Distance upstream (feet)													
>100	-	-	-	-	-	-	-	-	-	-	-	-	1
100	-	-	-	-	-	-	-	-	-	-	-	-	1
70	-	-	-	-	-	-	-	-	-	-	-	-	-
60	-	-	-	-	-	-	-	-	-	-	-	-	-
55	-	-	-	-	-	-	-	-	-	-	-	-	1
50	-	-	-	-	-	-	-	-	-	-	-	2	-
45	-	-	-	-	-	-	-	-	-	-	-	-	-
40	-	-	-	-	-	-	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	1
30	-	-	-	-	-	-	-	-	-	-	-	-	1
25	-	-	-	-	-	-	-	-	-	-	-	-	1
20	-	-	-	-	-	-	-	-	-	-	-	-	1
15	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-
Point of Placement	0	53	24	20	2	3	-	-	-	-	-	-	-
Distance down-stream (feet)													
5	-	-	3	2	2	-	-	-	-	-	-	1	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	1	1	-	1	2	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	1	1	1	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-
40	-	-	-	-	-	-	-	-	-	-	-	-	-
45	-	-	-	-	-	-	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-	-	-	-	-	-	-
55	-	-	-	-	-	-	-	-	-	-	-	-	-
60	-	-	-	-	-	-	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-	-	-	-	-	-	-
>90	-	-	-	-	1	-	-	-	-	-	-	-	-
Water temperature:	-	-	-	-	-	42F	39F	40F	40F	45F	44F	54F	58F

snails were encountered. The low recoveries observed on the sixth and ninth weeks resulted from high water and high turbidities from rains which occurred during those particular sampling periods. While possibly insufficient sampling time might also account for these low responses, the lengthy and careful searches that were made each time seem adequate.

Discussion and Conclusion. In spite of the washing away of many marked snails and in spite of the marked snails present but missed, from the remaining sample, description of the prob-

able relationship that exists between the relative positions of those marked snails and certain environmental factors is possible. From table 2, those snails found below the eddy pool, show no particular pattern as to the number of individuals or their distribution. However, the rain storms which occurred during the sample period, may be of significance with regard to the down stream distribution of the marked snails. During the sample period rains occurred during the weeks of 4, 11, and 18 January; 9 and 21 February; and 1 and 16 March. An examination of table 2 shows that the number of snails observed below the eddy pool can be correlated to the frequency of rain storms. Thus, supposedly the snails appearing below the eddy pool were washed down from above.

Whereas a poor pattern was observed for those snails encountered below the eddy pool, a very clear pattern is seen for those snails observed above it. (Table 2). The number of snails involved is remarkably constant, the exceptions to this having already been explained. In the distribution of these snails, a rather pronounced tendency for upstream establishment is noted. This tendency is seen as early as the 18 January sample and becomes much more striking after the 7 March sample (Table 2). It is even to be seen from those snails observed below the eddy pool. During periods when no rains fell, fewer marked snails were encountered below the eddy pool, and those that were, generally were found closer to that pool. This non-random distribution very likely demonstrates an oriented behavioral response. Although the causes of this response were not determined, apparently the more pronounced upward establishment might be correlated to the rise in water temperature recorded during this period (Table 2). Also possibly, some snails simply were not washed down during the rain storms and merely continued crawling upstream. Also, for those periods when no rains occurred, there were generally more marked snails encountered above the eddy pool than seen the immediately previous weeks in which rain did fall. This perhaps reflects the increased probability of snails becoming dislodged during periods of high water with higher velocities.

This behavioral response, the orientation to currents especially in streams, is known as rheotaxis (Fraenkel and Gunn,

1961). Whenever such a response occurs toward the source of the stimulus, as is the case here, it is said to be a positive one (Dethier and Stellar, 1961). Many bottom dwelling invertebrates such as isopods, amphipods, turbellarians, pulmonate gastropods, and insects found in lentic habitats are well known for their rheotactic behavior (Fraenkel and Gunn, 1961). However, this appears to be the first report of such a behavioral pattern in this species, and may represent a first report of rheotaxis in a fresh water prosobranch gastropod. In *Planaria alpina*, rheotactic behavior has been shown to have pronounced survival value (Beauchamp, 1933, 1937). This oriented response possibly has survival value for *Goniobasis proxima*, but this is yet to be substantiated.

SUMMARY

From a study of the movements of the snail, *Goniobasis proxima*, in a tributary stream of Bolin Creek, located approximately one mile north of Chapel Hill, North Carolina, data were gathered suggesting that upstream establishment in this snail is an oriented response. Fifty-three snails were marked and returned to an eddy pool adjacent the main stream flow. Checks on the number and position of the marked snails were made weekly for 15 weeks. Those snails in areas of the stream with an appreciable current were oriented against the current whereas those in other areas showed no particular upstream orientation. The presence of nearly 3 times as many snails above the eddy pool as below it indicated a strong tendency toward upstream establishment, a positive rheotactic response. This was even more pronounced during those periods free of rain which means that snails were not so readily dislodged during the rain free periods. This rheotactic response appeared to increase with the rise in water temperature although very possibly some snails escaped, being washed down during rain storms and therefore would attain the distances recorded in spite of the rise in water temperature.

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SUBGENERIC CLASSIFICATION OF PISIDIUM IN NORTH AMERICA

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In view of Boettger's (1961, 1962) and Kuiper's (1962a) efforts to classify the Palearctic and Ethiopian members of the sphaeriid clam genus *Pisidium* C. Pfeiffer, it is of interest to examine and compare the Nearctic and Holarctic species in North America. The soft-part anatomy (except for *P. cruciatum* and *P. insigne*), as well as the shell morphology, of all species listed here has been examined, and life history studies have been carried out on representatives of the 3 North American subgenera (Heard, 1965). All species are confined to the Nearctic Region unless otherwise designated.

Genus *Pisidium* C. Pfeiffer, 1821

Type: *Tellina amnica* Müller, 1774. Animals monoecious and ovoviviparous; only the anal siphon well-developed, the branchial siphon either rudimentary or represented by a cleft in the mantle. Shell inequipartite: anterior end longer than posterior end, beaks occasionally terminal; size comparatively small: 1.5-10 mm in length.

Subgenus 1, *Pisidium* s. str.

Type: *Tellina amnica* Müller, 1774. Branchial siphon rudimentary (*P. dubium*) or represented only by a slit in the partially-fused mantle; large posterior gills present in addition to large anterior gills; posterior gills with inner and outer lamellae; dorsal loop or lobe of each nephridium cleft; size large: 6-10 mm in length. Life history in the central Nearctic Region: one medium- (10 young) to large-sized (20) litter produced each year for several years.

Pisidium amnicum (Müller). Eurasia; introduced into North America.

Pisidium dubium (Say)

Pisidium idahoense Roper

Subgenus 2, *Rivulina* Clessin, 1873

Type: *Pisidium supinum* Schmidt, 1851 (subsequent designation by Clessin, 1879). Partially-fused mantle containing a short slit representing the branchial siphon; small posterior gills present in addition to larger anterior gills; posterior gills with inner lamellae only; dorsal loop or lobe of each nephridium cleft; medium-sized: 2.5-5 mm in length. Life history in the central Nearctic Region: annual species producing one small to large litter (average: 4-20).

Pisidium adamsi Prime

P. aequilaterale Prime

P. casertanum (Poli). Worldwide (see Herrington, 1962).

P. compressum Prime

P. fallax Sterki

P. ferrugineum Prime. Circumpolar (= *P. hibernicum* of Europe?)

P. henslowanum (Sheppard). Eurasia; introduced into North America.

P. lilljeborgi Clessin. Holarctic.

P. milium Held. Holarctic.

P. nitidum Jenyns. Holarctic.

P. obtusale C. Pfeiffer. Holarctic.

P. subtruncatum Malm. Holarctic.

P. supinum Schmidt. Holarctic (see Herrington, 1962, p. 41).

P. ultramontanum Prime

P. variabile Prime

P. walkeri Sterki

Subgenus 3, *Neopisidium* Odhner, 1921

Type: *Pisidium torquatum* Stelfox, 1918. Complete absence of branchial siphon and of posterior gills; dorsal loop or lobe of each nephridium united; small-sized: 1.5 - 3 mm in length; constant retention of juvenile characters. Life history in the central Nearctic Region: life span unknown; two small litters produced each year.

Pisidium conventus Clessin. Eurasia; Nearctic Region (see Heard, 1963a).

?*P. cruciatum* Sterki. Provisional placement in this subgenus.

?*P. insigne* Gabb. Provisional placement in this subgenus.

P. punctatum Sterki

P. punctiferum Guppy. Southern North America, Central America, and Caribbean islands.

For specific morphological differences between *P. punctatum* and *P. punctiferum* see Kuiper, 1962b; for their geographic differences see Heard, 1963b.

The subgenera *Afropisidium* Kuiper, 1962a (type: *Pisidium lepas* Kuiper, 1957), and *Odhneripisidium* Kuiper, 1962a (type: *Pisidium stewarti* Preston), have no known representatives in North America. These two taxa are reported to be anatomically closely related to *Neopisidium*, but each differs from the other subgenera in the position of the ligament. In *Pisidium* s.s., *Rivulina*, and *Neopisidium* the ligament is enclosed, contained in the hollow of the hinges of the two valves. However, in *Odhneripisidium* the ligament lies below the hinges of the valves at a right angle to the symmetrical plane of the shell, while the ligament in *Afropisidium* is external.

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SOUTHERN LIMIT OF *NASSARIUS TRIVITTATUS*¹

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The southern limit of the range of *Nassarius trivittatus* (Say) has been a matter of some controversy in the literature. Several popular shell books list this species from as far south as South Carolina (Abbott, 1954: 239) or northern Florida (Morris, 1947: 194; Smith, 1951: 121). Other authors, however, have reported that *Nassarius trivittatus* does not occur alive south of Cape Hatteras (Wells, Wells and Gray, 1961: 269; Wells and Richards, 1962: 590).

The purpose of this note is to report the verified collection of *Nassarius trivittatus* from the coastal waters off Georgia. One specimen was collected alive on November 11, 1964 at longitude 31°25'12"N. and latitude 81°12'30"W. (about 1.5 miles east of Sapelo Island). This specimen has been preserved with its soft parts extended and deposited in the United States National Museum (U.S.N.M. No. 636920). It was identified tentatively by the author, and this identification has been checked by Dr. J. P. E. Morrison, Dr. H. A. Rehder, and Dr. J. Rosewater of the U. S. National Museum. Additional specimens of this species had been collected from the same location during August 1964.

The collection of these live specimens of *Nassarius trivittatus* makes it clear that the species range includes Georgia. Numerous

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collections of the shells of this species from Florida waters indicate that the range probably extends south to St. Augustine. This hypothesis is supported by the collections in the U. S. National Museum, which Dr. J. P. E. Morrison has been kind enough to check. One of these collections (U.S.N.M. No. 54645) contains a shell and dried soft parts of a specimen collected off Cumberland Islands, Georgia, (near the Georgia-Florida border); and other collections (U.S.N.M. No. 46830, and U.S.N.M. No. 415502) contain what appear to be relatively fresh dead shells from areas near the mouth of the St. John's River and the beach at St. Augustine (Dr. J. P. E. Morrison pers. comm.).

It appears therefore that the extreme southern limit of the range of *Nassarius trivittatus* is in Georgia or Florida rather than at Cape Hatteras. The occurrence of this species near the southern limit of its range may be intermittent, but the density of the population off Georgia occasionally reaches 4 individuals per square meter. This population certainly is large enough to provide most of the shells which are found on southern beaches, although some of these shells may come from fossil or sub-fossil deposits.

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NEW RECORDS OF CADULUS (SCAPHOPODA) FROM THE NEW ENGLAND AREA

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Two species of small scaphopod mollusks were obtained from benthic fauna collections taken by the U. S. Bureau of Commercial Fisheries in offshore New England waters during the past

few years. One species, *Cadulus (Platyschides) rushi rushi* Pilsbry and Sharp, 1898, occurred in samples from the Gulf of Maine. The other species, tentatively identified as *Cadulus (Platyschides) agassizi* Dall, 1881, occurred in samples from moderately shallow water along the southern side of Georges Bank. Some doubt concerning the identity of those specimens tentatively identified as *C. agassizi* results from their slightly longer length and proportionately greater width than is typical for the species (Dr. W. K. Emerson, personal communication).

These records are noteworthy because (1) the genus *Cadulus* has not heretofore been reported from the Gulf of Maine; (2) *C. r. rushi* has not previously been found in such shallow water or as far north; and (3) *C. agassizi* is a southern form that has not been reported from the New England region.

I wish to thank Dr. Joseph Rosewater, U. S. National Museum, and Dr. William K. Emerson, American Museum of Natural History, for identifying these specimens.

CADULUS R. RUSHI

Twenty-four specimens of *C. r. rushi* were obtained at 11 localities in the north-central section of the Gulf of Maine (Fig. 1) by the research vessel *Delaware* on cruise number 61-10, June 23-29, 1961. Collecting devices were a Smith-McIntyre grab sampler and a naturalist's dredge. Shell length of undamaged specimens ranged between 11 and 13 mm. Eleven specimens were alive at the time of capture. Occurrence records and associated data are listed in Table 1. At the localities where these specimens were taken, the water depths ranged from 210 to 256 m. and the bottom sediment at every station was predominantly a mixture of silt and clay of olive-brown color.

A good indication that *C. r. rushi* is restricted to the deeper portions of the Gulf of Maine was its absence in collections from shallow water. No specimens of this species (or genus) occurred in 86 other samples (76 localities) taken on the same cruise at sampling stations spaced 16 km. apart over the northern half of the Gulf. These collections included 23 samples from depths less than 210 m. A deep-water habitat is not unexpected, since the previously established minimum depth for this species was 361 m. (Johnson, 1934). The bathymetric range for *C. r. rushi*, as presently known, is from 210 to 2,811 m. These figures are from Gulf

Table 1. --Collection and specimen data for *Cadulus r. rushi* from research vessel Delaware Cruise 61-10, in the Gulf of Maine, June 23-29, 1961 ^{1/}

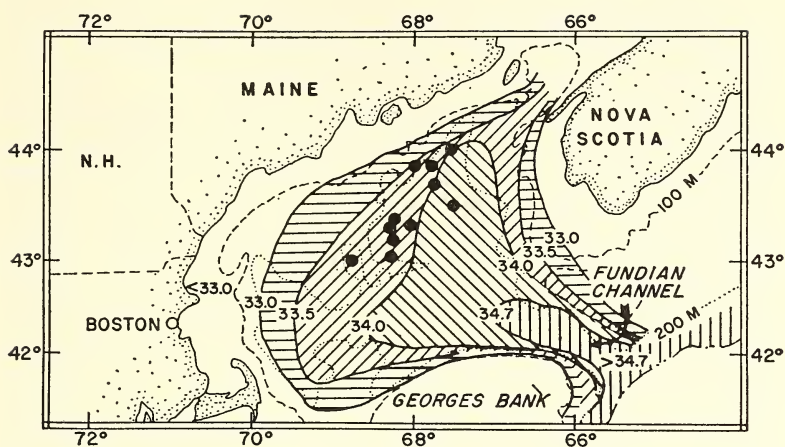
Station number	Location		Water depth (m)	Bottom water temperature (C)	<i>C. r. rushi</i>	
	Latitude (North)	Longitude (West)			Number	Length (mm) ^{2/}
26	43°01'	68°45'	220	5.3	2	13, (9-1/2)
55	43°20'	68°01'	247	6.6	1	11
56	43°20'	68°15'	229	6.1	3	13, (5), (2-1/2)
73	43°30'	67°21'	238	6.5	1	(4)
83	43°41'	67°46'	238	6.6	1	(5)
91	43°50'	68°00'	210	6.1	1	(9)
92	43°50'	67°45'	256	6.4	5	(9), (6), (6), (2-1/2), (1-1/2)
101	44°00'	67°30'	242	6.1	3	13, 12, (4)
108	43°20'	68°17'	216	6.7	2	12, (4)
109	43°10'	68°17'	234	5.6	3	12, (7-1/2), (4)
110	43°00'	68°15'	210	5.0	2	13, (10)

^{1/}--Bottom sediments at all stations are olive-brown mixture of silt and clay.

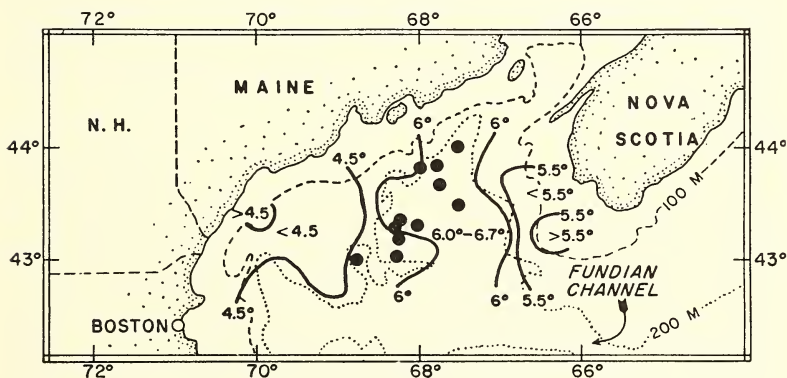
^{2/}--Lengths of incomplete shells are enclosed in parentheses.

of Maine data listed in Table 1, and the maximum depth reported by Henderson (1920) and Clarke (1962).

The geographic range of *C. r. rushi*, as reported by Johnson (1934), extends from Cape Hatteras northward to the vicinity of Georges Bank. Thus its occurrence in the Gulf of Maine — where so far as known it is the only *Cadulus* present — is farther northward than would generally be expected, due to the prominent zoogeographic boundary formed by Cape Cod and Georges Bank. A feature of Gulf of Maine hydrography provides, however, a reasonable explanation why a mollusk from the continental shelf and slope along the eastern coast of the United States could also inhabit certain sections of the Gulf. Bottom water in the deep portions of the Gulf where *C. r. rushi* occurs has a higher salinity than shallower parts. This high-salinity bottom water enters the Gulf through the Fundan (Eastern) Channel (Bigelow, 1927). It spreads northward and westward into the deepest portions of the Gulf (Fig. 1), producing an environment somewhat similar to that on the shelf and slope outside the Gulf. Although salinity measurements were not made at the time these samples were collected, the seasonal and year-to-year changes in bottom-water salinity in the central Gulf are small. The salinity



1. Geographic distribution of *Cadulus r. rushi* in the Gulf of Maine, and the salinity of bottom water. The salinity data were collected August-September 1964.



2. Geographic distribution of *Cadulus r. rushi* in the Gulf of Maine, and the bottom-water isotherms ($^{\circ}\text{C}$), June 1961.

gradient of bottom water illustrated in Figure 1 is based on data collected September 1964 aboard the R/V *Albatross IV* (data provided by J. B. Colton, personal communication). On the basis of the information now available, the minimum salinity of Gulf of Maine waters inhabited by *C. r. rushi* appears to be near $33.5^{\circ}/\text{00}$.

The high-salinity bottom water that enters the Gulf of Maine through Fundian Channel also has a higher temperature than other Gulf bottom water. At the stations where *C. r. rushi* occurred the bottom temperature at the time the scaphopods were collected ranged from 5.0 to 6.7 C (41-44 F). The distribution of this species in relation to bottom-water temperature in June 1961 is illustrated in Fig. 2. Low water temperature does not appear to be a major deterrent factor in the geographic distribution of this species in the Gulf of Maine, inasmuch as Henderson (1920) has reported its occurrence in slope waters south of the Gulf of Maine at a temperature as low as 2.7 C (36.9 F). The temperature of bottom water in the central Gulf of Maine is rarely less than 4 C (39.2 F). High temperature, however, may be limiting because the Gulf bottom water in some sectors occasionally rises to 8 C (46.4 F). This value is slightly higher than the maximum water temperature (6.6 C or 44 F) associated with *C. r. rushi* as reported by Henderson (1920).

Shell fragility is indicated by the high percentage of broken shells — 16 of 24. The habitat, which consisted of fine-textured sediments in deep-water areas where water currents are generally weak, would not be expected to handicap seriously a thin-shelled species.

CADULUS AGASSIZI

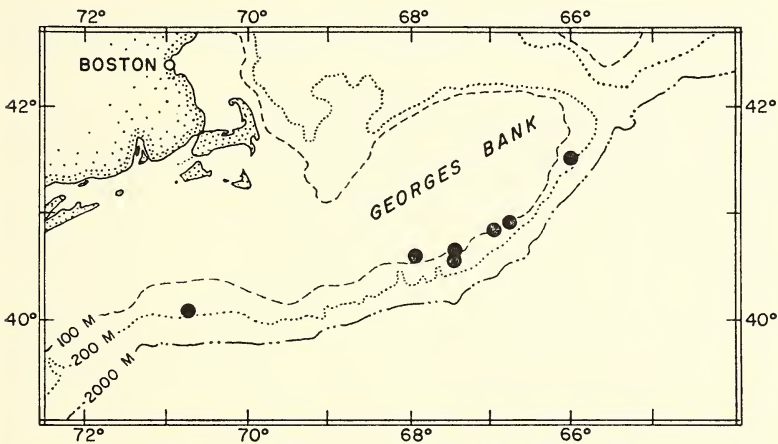
A total of 10 specimens of *C. agassizi* were collected at six stations along the southern periphery of Georges Bank and at one station south of Martha's Vineyard near the edge of the continental shelf. Four of these specimens were collected with a Smith-McIntyre grab sampler, 4 with a trawl, and 2 with a scallop dredge. Shell lengths of the smallest and largest specimens were 7½ and 11 mm. Six of the specimens were alive at capture. The collection data together with the number and size of specimens are listed in Table 2; localities of collection are shown in Fig. 3.

The geographic range for this species has previously been reported as extending from the Florida Keys northward to the Chesapeake Bay region (Johnson, 1934). Thus its occurrence on Georges Bank extends its known range a considerable distance northward and eastward.

Sediments at localities in the Georges Bank region where *C. agassizi* was found were of moderately coarse texture, ranging

Table 2. --Collection and specimen data for *Cadulus agassizi* from the Georges Bank region, 1955-61

Location		Water depth (m)	Date collected	Bottom sediment	<i>C. agassizi</i>	
Latitude (North)	Longitude (West)				Number	Length (mm)
40°35'	67°59'	84	November 17, 1955	Gravelly sand	1	10
40°37'	67°28'	86	August 24, 1957	Coarse sand	1	9-1/2
40°50'	66°58'	91	November 19, 1955	Fine sand and shell	3	11, 9, 8-1/2
40°54'	66°46'	102	August 28, 1957	Fine sand and shell	1	9-1/2
40°33'	67°28'	117	August 24, 1957	Medium sand	1	8
41°30'	66°00'	145	August 26, 1957	Gravelly sand	1	8
40°02'	70°47'	146	January 26, 1961	---	2	9, 7-1/2



3. Geographic distribution of *Cadulus agassizi* in the Georges Bank region.

from mixtures of fine sand with shell fragments to sandy gravels. This finding agrees well with sediment types at points of collections of *C. agassizi* reported by Henderson (1920) off the southeast coast of the United States. A large proportion of the collections he cited were from sand substrates or mixtures of sand with shell or rock.

This species has been reported from depths of 31 to 538 m. (Johnson, 1934), and most of the records are from depths between 91 and 274 m. (Henderson, 1920). It was collected from the Georges Bank region at depths between 84 and 146 m., well within the known depth range for the species.

The absence of broken shells of this species suggests that their shells are more durable than those of *C. r. rushi*. This condition would be advantageous for a species such as *C. agassizi* which lives in coarse-textured sediments and at moderate water depths, where water currents are likely to be stronger than in areas of sediment deposition.

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CHANGES IN PELECYPOD POPULATIONS IN SALT FORK OF BIG VERMILION RIVER, ILLINOIS, 1918-1962¹

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In the years of 1918 through 1920, Frank Collins Baker made a survey of the mollusks in the upper reaches of the Big Vermilion River in east-central Illinois (Baker and Smith, 1919; Baker, 1922). His study was carried out primarily in the Salt Fork of that river system, and he gave special attention to the pelecypods. He established 30 collecting stations from the headwaters north of Urbana to the junction of this branch with the Middle Fork and the North Fork Rivers just west of Danville where together they form the Big Vermilion River. Baker collected over a stream distance of 45 miles by hand-collecting in shallow water to a depth of two feet. H. J. Van Cleave (1940) studied the bivalve population at one of Baker's stations (Station 25) between 1930-39, and published the results of his annual census. (The junior writer was a member of the survey party for

¹ This study was supported in part by the University of Illinois Research Board and the Environmental Sciences Branch of the United States Atomic Energy Commission, Contract No. AT (11-1)—411.

TABLE 1. -- Comparison Of Pelecypod Populations In The Salt Fork Of
The Big Vermilion River, Illinois, 1918-62
First symbol is number collected by F. C. Baker, 1918-20; second symbol is number collected by
R. W. Dexter and/or M. R. Matteson, 1958-62. A = abundant; C = common; S = scarce.

Species	Station Numbers														
	1	2	3	4	5	6	7	8	9	12	13	14	15		
Sphaeriidae															
<i>Sphaerium</i> spp.		A-1		C-0											
<i>Sphaerium</i> (<i>Musculium</i>) spp.			A-S	C-0								S-0			
<i>Pisidium</i> spp.												S-0			
Unionidae															
<i>Carunculina parva</i>	C-0			C-0											
<i>Unioleus tetralasmus</i>	C-0			C-0											
<i>Anodontoides ferussacianus</i>	C-0	C-0		C-1											1-0
<i>Anodonta grandis</i>				A-3											
<i>Anodonta corpulenta</i>				A-0											

TABLE 1 con't. -- Comparison Of Pelecypod Populations In The Salt Fork Of
The Big Vermilion River, Illinois, 1918-62

Species	Station Numbers														
	16	17	18	19	20	21	22	23	24	25	26	28	30		
Sphaeriidae															
<i>Sphaerium</i> spp.	C-0	A-0	A-0							A-0					
<i>Sphaerium</i> (<i>Musculium</i>) spp.			A-0										C-0		
<i>Pisidium</i> spp.					A-0						S-0				
Unionidae															
<i>Carunculina parva</i>			A-0		C-0		G-1			C-S	1-0				
<i>Anodontoides ferussacianus</i>				1-0						S-0	C-0				
<i>Anodonta grandis</i>	S-0	S-0	C-0	C-0	C-0		0-3	S-0	S-0	A-3	0-2	0-1	C-0		
<i>Lampsilis siliquioidea</i>	S-0	C-0		S-0	S-0		C-2	C-0	A-0	A-5	A-1	A-6	A-2		
<i>Microgona lienosa</i>			1-0	S-0				C-0	C-0	A-S	S-0	A-0	S-0		
<i>Lasimigona complanata</i>	S-0	S-0	A-0	C-0	A-0	A-0	A-2	A-S	A-15	A-33	0-1	A-5	A-3		
<i>Fusconia filava</i>	2-0	1-0	C-0	A-0	1-0		S-0	S-2	S-9	A-38	C-1	A-15	C-1		
<i>Amblesma costata</i>	C-0	A-0	A-0	1-0	A-0		C-1	A-0	A-5	A-13	A-0	A-2	A-2		
<i>Quadrula pustulosa</i>		S-0	S-0					S-2	0-4	C-35	C-1	1-2	C-2		
<i>Carunculina glans</i>										S-0					
<i>Strophitus rugosus</i>								S-1	S-0	C-5		0-1	S-0		
<i>Lasimigona costata</i>							1-0	C-0	C-0	C-S	C-0	C-1	C-0		
<i>Alasmidonta marginata</i>							1-0	S-0	S-0	C-2	C-0	1-1	C-0		
<i>Pleurobema coccineum</i>								C-2	S-1	C-13	0-1	0-1			
<i>Lampsilis ventricosa</i>			A-0					C-0	C-0	A-52	A-2	A-19	A-3		
<i>Anodonta imbecilis</i>					C-0					C-S					
<i>Lampsilis anodontoides</i>										S-0					
<i>Lampsilis fasciola</i>										2-10	C-0	0-4	C-0		
<i>Actinonaias ellipsiformis</i>										S-S	S-0		1-0		
<i>Actinonaias carinata</i>										S-39	C-0	0-6	A-1		
<i>Quadrula quadrula</i>										S-10		0-2	0-2		
<i>Quadrula metanevra</i>										S-1	S-0	2-1	C-0		
<i>Cyclonaias tuberculata</i>										S-32		0-1	C-0		
<i>Tritogonia verrucosa</i>								0-1	0-2	C-48	C-0	0-7	C-2		
<i>Obovaria subrotunda</i>										S-0	S-0	C-0	C-0		
<i>Pleurobema clava</i>										1-S	A-1				
<i>Quadrula cylindrica</i>												1-0			
<i>Megalomias gigantea</i>															
<i>Microgona iris</i>										0-S					
<i>Lasimigona compressa</i>								S-0		0-S					

1934.) The present writers subsequently made a resurvey of all Baker's stations in the Salt Fork proper, but excluded four located in tributaries to the Salt Fork, between 1958-1962. A report has been published on changes in the gastropod populations of the Salt Fork by comparing the recent survey with Baker's results obtained some 40 years earlier (Dexter, 1961). We have combined our recent observations on pelecypods and compared our results with the earlier surveys of Baker and Van Cleave to determine changes which have occurred in the pelecypod populations since their work was completed. An account of the habitats, pollution, and general information concerning the Salt Fork will be found in the earlier reports (Baker, 1922; Dexter, 1961). Pollution enters primarily at Station 5, but the

Table 2. Comparison of Unionidae Collected at Station 25,
Salt Fork River, Illinois.

	A=abundant; Baker 1918-20	C=common; S=scarse; R=rare Van Cleave 1930-39	Matteson- Dexter 1956-62
<i>Lampsilis ventricosa</i>	A	A	A
<i>Tritogonia verrucosa</i>	C	A	A
<i>Lasmigona complanata</i>	A	A	C
<i>Fusconaia flava</i>	A	C	C
<i>Quadrula pustulosa</i>	C	C	C
<i>Amblema costata</i>	A	C	S
<i>Lampsilis siliquoidea</i>	A	S	R
<i>Cyclonaias tuberculata</i>	S	S	C
<i>Actinonaias carinata</i>	S	S	C
<i>Lampsilis fasciola</i>	R	S	S
<i>Pleurobema coccineum</i>	C	S	S
<i>Lasmigona costata</i>	C	S	S
<i>Anodonta grandis</i>	A	S	R
<i>Strophitus rugosus</i>	C	S	R
<i>Alasmodonta marginata</i>	C	S	R
<i>Micromya lienosa</i>	A	S	S
<i>Quadrula metanevra</i>	S	S	R
<i>Carunculina parva</i>	C	R	S
<i>Quadrula quadrula</i>	S	R	S
<i>Pleurobema clava</i>	R	R	S
<i>Ligumia ellipsiformis</i>	S	R	S
<i>Anodonta imbecilis</i>	C	R	S
<i>Carunculina glans</i>	S	R	
<i>Obovaria subrotunda</i>	S	R	
<i>Lasmigona compressa</i>	S	R	
<i>Anodontoides ferrussacianus</i>	S		
<i>Lampsilis anodontoides</i>	S		
<i>Unionerus tetralasmus</i>		R	
<i>Quadrula cylindrica</i>		R	
<i>Micromya iris</i>		R	S
<i>Megalonaia gigantea</i>			S

increasing effluent over the years has been treated with increasing effectiveness so that the total amount of pollution has remained at a fairly uniform level.

Comparison of pelecypod populations (1918-1962)

Tables 1 and 2 summarize the collecting samples of Baker (1918-20) and those of Matteson and Dexter (1958-62). Baker found 3 groups of Sphaeriidae (*Sphaerium*, *Sphaerium* (*Musculium*), and *Pisidium*) to be abundant and widely distributed. We found no *Pisidium* and only a few specimens of *Sphaerium* which were confined to the headwaters.

Baker found 30 species of Unionidae. We found 25 species, including two not recorded by Baker (*Megalonaia gigantea* and *Micromya iris*). The 7 species found by Baker but not taken in the latter survey are *Unio merus tetralasmus*, *Anodonta corpulenta*, *Carunculina glans*, *Lasmigona compressa*, *Lampsilis anodontoides*, *Obovaria subrotunda*, and *Quadrula cylindrica*. Since the Baker survey, there has been a decrease in abundance for these 20 species.

<i>Carnuculina parva</i>	<i>Lasmigona costata</i>
<i>Anodontoides ferussacianus</i>	<i>Alasmidonta marginata</i>
<i>Anodonta grandis</i>	<i>Pleurobema coccineum</i>
<i>Lampsilis siliquoidea</i>	<i>Lampsilis ventricosa</i>
<i>Micromya lienosa</i>	<i>Anodonta imbecilis</i>
<i>Lasmigona complanata</i>	<i>Lampsilis fasciola</i>
<i>Fusconaia flava</i>	<i>Actinonaias ellipsiformis</i>
<i>Amblema costata</i>	<i>Quadrula metanevra</i>
<i>Quadrula pustulosa</i>	<i>Tritogonia verrucosa</i>
<i>Strophitis rugosus</i>	<i>Pleurobema clava</i>

Two species have remained about the same in abundance (*Actinonaias carinata* and *Cyclonaias tuberculata*). A single species increased in abundance (*Quadrula quadrula*). Since the Baker survey, 13 species have become more restricted in range, six species have about the same range, and four species have increased their range in the Salt Fork system.

In the recent survey, we found 16 collecting stations with fewer species; and only one station (No. 28) had more species (17 against 12 formerly). We found 17 stations with less abundance of Unionids, and no station showed an increase in abundance of total populations.

More restricted in range:	<i>Actinonaias ellipsiformis</i>
<i>Carunculina parva</i>	About same range:
<i>Anodontoides ferussacianus</i>	<i>Strophitis rugosus</i>
<i>Lampsilis siliquoidea</i>	<i>Lampsilis fasciola</i>
<i>Micromya lienosa</i>	<i>Actinonaias carinata</i>
<i>Lasmigona complanata</i>	<i>Pleurobema clava</i>
<i>Fusconaia flava</i>	<i>Quadrula metanevra</i>
<i>Amblema costata</i>	<i>Cyclonaias tuberculata</i>
<i>Quadrula pustulosa</i>	Increased in range:
<i>Alasmidonta marginata</i>	<i>Anodonta grandis</i>
<i>Lasmigona costata</i>	<i>Quadrula quadrula</i>
<i>Lampsilis ventricosa</i>	<i>Tritogonia verrucosa</i>
<i>Anodonta imbecilis</i>	<i>Pleurobema coccineum</i>

Comparison of Van Cleave's study of station 25 (1930-39) and the survey of Matteson and Dexter (1958-62). *Lampsilis ventricosa* remained the most common species, and *Tritogonia verrucosa* remained the second most common species. *Lasmigona complanata*, however, has fallen from third place as most numerous and in recent years has been less numerous than *Quadrula pustulosa*, *Fusconaia flava*, and *Actinonaias carinata*. *Cyclonaias tuberculata* has increased somewhat in abundance. Six species dropped out from the samples. However, these were only rarely collected by Van Cleave, (*Unio merus tetralasmus*, *Actinonaias ellipsiformis*, *Carunculina glans*, *Quadrula cylindrica*, *Obovaria subrotunda*, and *Lasmigona compressa*).

Comparison of unionids at station 25 sampled by Baker—Van Cleave—Matteson and Dexter. Station No. 25, until recently, was a shoal below an artificial dam. In recent years, the dam has been washed away. This station has been the best collecting site in the Salt Fork system. Baker found 27 species, two of which were not collected in subsequent surveys; but both were scarce in Baker's original collection (*Anodontoides ferussacianus* and *Lampsilis anodontoides*). Baker did not find *Micromya iris*, which was found in both of the later surveys. Baker did not get *Unio merus tetralasmus* and *Quadrula cylindrica*, which were found only by Van Cleave in small numbers at Station 25, but Baker was able to collect *U. tetralasmus* at Stations 1 and 4, and he collected 1 specimen of *Q. cylindrica* at Station 28. Van Cleave found a total of 28 species, and we found 24 species. In the later years, *Carunculina glans*, *Obovaria subrotunda*, and *Lasmigona*

compressa, found rarely by Baker and Van Cleave, were not collected at all. Matteson collected the only record of *Megalonaïas gigantea*.

General comparisons. Only Baker collected *Anodonta corpulenta*, which he obtained from Station 4. Matteson collected one specimen of *Anodontoïdes ferussacianus* at Station 4, but not at Station 25 where Baker found it scarce, and it was unreported by Van Cleave.

No bivalve was collected by anyone from Stations 5-9 and 12-13. These 7 stations follow in sequence along the main channel from the sewage inlet at Urbana. Bivalves were not collected along that stretch up to Station 14, a few miles below St. Joseph. Since 1918-20, 10 species have shown a marked decrease in abundance, and only 2 species have shown an increase in abundance.

CONCLUSIONS

In general, the pelecypod populations declined drastically since 1918. There are fewer species at present, and they have a more restricted distribution. Many species are found in small numbers and in only a few localities. With the exception of Station No. 25, abundance in general has declined; and even at Station 25, $\frac{1}{3}$ of the species have declined in abundance since the original survey.

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A NEW STREPTOSTYLA FROM NICARAGUA

By MORRIS K. JACOBSON

Associate, American Museum of Natural History

Among molluscan material recently received from the north central part of Nicaragua are specimens representing an appar-

ently undescribed species of *Streptostyla*.

STREPTOSTYLA (CHERSOMITRA) **VANCEGREENEI**, new species. Fig. 1
Diagnosis: A *Streptostyla* from north central Nicaragua, characterized by having a short, moderately twisted columellar cord with a thinly superposed white callous edge, and a sharply elevated protoconch.

Description: Shell thin, elongate-ovate, orange-brown, glossy, except for moderately coarse, uneven growth lines. Whorls 7, weakly rounded, very gradually descending but somewhat more sharply near the aperture. Protoconch smooth, glossy, same color as the rest of the shell, sharply elevated over the first post nuclear whorl. Body whorl moderately inflated, peristome barely convex, in fully mature specimens almost parallel with the axis. Suture shallow, edged by a regularly outlined, slightly darker, impressed line. Aperture narrow, more than one-half the length of the shell, columella with a moderately twisted, entering columellar fold, thinly edged with a white callous cord.

Holotype: Length 25.6, diameter 12.3, length of aperture 16.5 mm

Paratype: Length 20.2, diameter 9.6, length of aperture 12.5 mm

Paratype: Length 28.3, diameter 13.5, length of aperture 17.5 mm

Discussion: The new species is easily separated from the shell of *S. gabbi* Pilsbry by the more inflated outline, the sharply raised protoconch, the uniformly orange-brown color not becoming paler at the spire, the dark rather than white sutural band, and in having 7 rather than 5 whorls. In addition, the body whorl of *S. vancegreeniei* does not descend as sharply at the aperture, and the growth lines are distinctly stronger. It differs from *S. delibuta* Morelet in color, in having a smooth rather than a regularly wrinkled sutural line, and in the nature of the columellar cord. It has the conic spire of *S. obesa* von Martens, but it has a much smaller and smoother shell.

Type Locality: Quemigüas (Quimiqüas) or Tigre Negro, approximately 20 miles northwest of Bonanza, Zelaya Department, Nicaragua, approximately 14° 12' N., 84° 37' W., elevation (estimated) 1300'. Collector: Vance Greene, geologist with the Neptune Mining Co., Bonanza, Nicaragua, June 1965, for whom the shell is gratefully named. Mr. Greene added the following ecological notes: Rock type: volcanic flows (andesitic), probably of late Tertiary age: No known limestone in area. Specimens

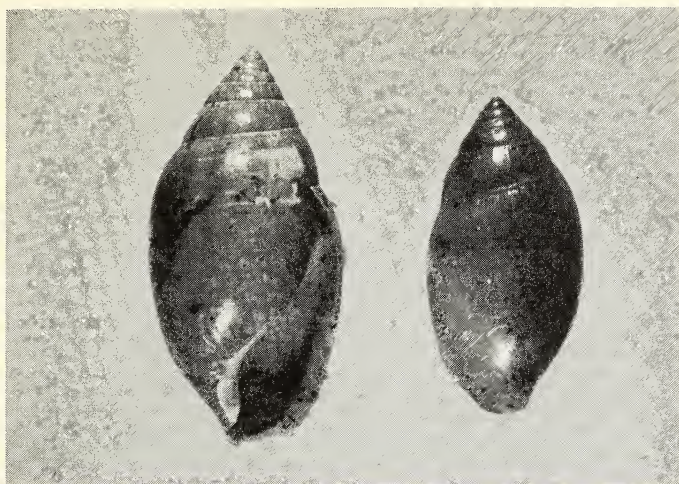


Fig. 1. *Streptostyla* (*Chersomitra*) *vancegreeni* Jacobson. Holotype and paratype.

were collected on the flank of a hill having approximately 300' relief. Almost all the snails collected were found at the base of an outcrop of andesite. Trees in the area were those common to the north central part of Nicaragua: coma negra, guarumo, etc. Associated molluscan species were: *Helicina rostrata* Morelet, *H. oweniana* Pfeiffer, *Neocyclotus bisinuatus* (von Martens) (= *dysoni* Pfeiffer?), *Leptinaria* sp.?

Type Depository: Holotype (121676), 3 paratypes (121677) consisting of one mature, worn specimen, one fresh, immature specimen, and one fragment, all in American Museum of Natural History.

Acknowledgements: I gratefully acknowledge the generous assistance of Dr. Joseph P. E. Morrison of the United States National Museum and of Dr. H. Burrington Baker of the Academy of Natural Science of Philadelphia for making available material for comparison. Dr. William K. Emerson of the American Museum of Natural History kindly read the manuscript.

NOTES AND NEWS

COURTSHIP BETWEEN *MONADENIA FIDELIS* AND *M. INFUMATA*: — The pair were noted in courtship at 12:20 P.M., February 16, 1953. I am indebted to Allyn G. Smith for collecting and sending

the *M. infumata* (Gould). He collected the two adults June 8, 1952 at Mt. La Salle, above Christian Bros. Winery, Nopa Co., California. The specimen of *M. fidelis* was laboratory reared, and was much smaller than the field-collected *infumata* which measured about 41 mm. in greater diameter.

As first noted in courtship in my fruit-cellar laboratory, the pair were in the head-arching stage of courtship. The *fidelis* and *infumata* were exchanging bite for bite on the foreparts in the typical fashion of courtship pairs of *M. fidelis* (Gray), (Webb, Gastropodia (1952) 1:1:1-3).

The body color of the two specimens is much alike. The edge of the sole of the *infumata* is just a bit more brilliant—being yellowish-gray where that of the *fidelis* is a whiter, clearer gray. The *infumata* was crawling rapidly in a clockwise pivot as it hung from the cage cover-glass. The atrial pore of the *infumata* at 12:45 P.M. was widely dilated and slightly out-bulging. The pair rejoined head-on. The atrial pore of the *fidelis* was dilated and projected outward about 8 mm. At 12:48 P.M. head-arching was resumed; each biting at the other snail's foreparts. This continued until about 1:05 A.M. (Feb. 17) when both pivoted; the bulging of the atrium continued in the *fidelis* but the *infumata* showed only a great dilation of the genital pore without outward convexity.

By 1:12 the *infumata* had gone sufficiently far forward to reach the *fidelis* again, but then, for causes not apparent to me, the pair again pivoted counterclockwise. At the completion of the pivot, the *fidelis* returned to the slim-spot marking the site where the courtship was initiated, and began to gnaw at the slime.

The *infumata* completed its pivot and was bitten by the *fidelis*. I observed that the *fidelis* genitalia were not protruded yet to the bell-shape noted in *fidelis* x *fidelis* matings. At 1:19 head-arching and biting continued; at 1:22 the *fidelis* protruded the genitalia as a bell-shaped organ; at 1:35, the *infumata* crawled around the *fidelis*, but the pair soon rejoined in a rather poor position. At 2:12 A.M. the *fidelis* dilated the exerted vaginal disk widely and pressed it mostly against the foot of the other snail. Then, on the vaginal disk, the dart-organ appeared as a recurved, tubular, loop, immediately followed by an obscuring, copious, whitish, secretion, presumably the ejects of the mucous

gland. Then the penis of the *fidelis* began to engage the atrial pore of the *infumata* (which had never everted or protruded its own sex-organ beyond the dilation stage described above). As the *fidelis* tried to insert its penis into the genital pore of the *infumata*, the latter kept moving away so that the penis-contact was disrupted. Under the conditions no spermatophore-transfer was begun. At 2:20 the penis of the *fidelis* was slowly retracted; at 2:21 the *infumata* returned head-on to the *fidelis*, which was lapping up the whitish secretion it had released. Again the *fidelis* inserted its penis, but again the *infumata* broke the contact before spermatophore-egress could be initiated.

At 2:40 the *infumata* still had a dilated genital pore but sex-union between the two snails had not been effected and seemed unlikely. The failure of the organs of the *infumata* to respond is noteworthy and puzzling. Perhaps the necessary courtship process is quite different in *infumata* (I have yet to witness it), and the proceedings did not stimulate the *infumata* to a degree sufficient to enable it to respond. About this time, 2:45 A.M., the observations were discontinued. Although quite unsatisfactory in many respects, the observations do indicate that a decided barrier to matings between these two species probably exists. — GLENN R. WEBB, Kutztown State College, Pa.

POMACEA BRIDGESI (REEVE) IN FLORIDA.—This Brazilian species was received recently from Dr. G. W. Dekle, Entomologist for the State of Florida, Division of Plant Industry, Gainesville. The original live specimen was found in a fish pond by Mr. C. F. Dowling on the eastern shore of Finger Lake, Miami, Florida. This lake is bounded by SW 53rd Avenue and 55th Avenue and 101st Street and 105th Street. The fish pond drains into Finger Lake.

This snail is being sold by aquarium supply dealers and it may be expected to appear elsewhere in time. The M.C.Z. has specimens from Furo Maguary, Belem, Pará; Amazon River at Villa Bella; Obidos; and Santarem, Brasil. —W. J. CLENCH.

POMACEA BRIDGESI IN PUERTO RICO.—This Brazilian species has been introduced into Puerto Rico at Mayagüez. Dr. Rebecca Brown of the School of Medicine, Boston University, brought in a specimen of this species for determination. Several additional

specimens were obtained through the kindness of Dr. M. H. Gaskins, officer in charge of the U.S. Department of Agriculture Experiment Station, who had collected them in a small pond back of the main building of the station at Mayagüez in March, 1965. Dr. R. D. Turner collected in this same pond in August, 1956, but found only *Australorbis*. In June, 1958, Dr. Allan Archer of Tift College, Forsythe, Georgia, collected a single specimen of this species in the same pond. This is a possible indication of the approximate date the species was first introduced into Puerto Rico. —W. J. CLENCH.

STRANDED CAMPELOMA.—During March, 1964, the Ohio River had one of the severest floods in recorded history. At Louisville, Kentucky, floodplain areas were inundated for several days and many spots along the bank remained under water long after the higher discharges subsided. Quantitative samples showed that most *Campeloma crassula* were aggregated in shallow water from late February through these floods. Many of the snails had followed rising water up the bank and numerous specimens were collected up to 12 meters from the usual waterline.

On the morning of April 28, 1964, the river began to recede from low areas of the bank. Most *Campeloma* that were left in these areas by the rapidly falling water level, responded by actively migrating toward the waterline. Upon reaching water, most snails burrowed into the sandy bottom where they remained as the water receded further, usually leaving them stranded. Animals on patches of firm clay continued on to deeper water, apparently seeking material to burrow in. The kind of substratum and its moisture content affected the success of these migrations. The average speeds of 19 snails on various surfaces were: 19.2 cm./min. underwater, 13.2 cm./min. out of water on mud, and 7.8 cm./min. on moist sand. Those traveling on sand were often immobilized since the substratum dried quickly, whereas muddy areas dried more slowly and the movement of snails was less impaired. None of the animals attempted to burrow while out of water. All snails were moving toward the river channel. However, tracks indicated that those trapped in isolated pools would first move around the edge of a puddle, then on to its deepest area where they burrowed into the bottom. These

directed movements of *Campeloma* were conceivably in response to a moisture gradient in the substratum; however, no experiment was carried out to explore this possibility.

Twenty-seven specimens that were ashore on dry portions of the bank for 52 hrs. were placed in aquaria with river water. Within 20 min., 11 were moving about actively and after 40 min. all had recovered. No live individuals were found among 17 specimens that were similarly treated after about 5 days of exposure. The ability of *C. crassula* to survive out of water for relatively short periods is seemingly due to the moisture retaining capabilities of its shell and tight fitting operculum. Individuals that were partially buried in either sand or mud apparently gained no advantage in survival.

The aggregation of *Campeloma* in shallow areas was presumably a negative response to increased current. During the period that the population was in shallow water, there was a strong current in the main channel from discharges that averaged from 150,000 to 690,000 cfs. Current had decreased and discharges averaged less than 50,000 cfs. at Louisville in mid May when these organisms were again more evenly distributed over the bottom. The numbers of *Campeloma* were not reduced during the flood as were the densities of other mollusks in the area. Relationships, if any, between these responses and the positive rheotactic movements of *C. decisum* demonstrated by Bovbjerg (Ecology 33:169-176, 1952) remain uncertain. — DAVID BICKEL, The Potamological Institute, University of Louisville, Louisville, Kentucky.

CAMPELOMA CRASSULA WITH REVERSED WHORLS.—During a recent study of the fresh-water mollusks of the Ohio River at Louisville, Kentucky, seven out of the 282 specimens of *Campeloma crassula* Raf. examined had reversed whorls. The 7 sinistral shells had heights of 18.5, 12.0, 6.2, 5.6, 5.4, 3.5, and 3.4 mm. The 4 smaller specimens were among young juveniles born in May and June, 1964. Shell height at birth of *C. crassula* in the Ohio River fell in a 3 mm. size class, with the smallest free-living young measuring 2.6 mm. This was about 1 mm. shorter than the shell heights at birth of *C. rufum* in the Salt Fork River, Illinois, reported by Van Cleave and Altringer (Am. Nat. 71:167-184,

1937).

The sinistral shells were more loosely coiled than those of normal specimens. However, the number of whorls corresponded with those on dextral animals of similar size, and the juveniles fit into age classes along with normal individuals. The abnormal juveniles accounted for 8% of all the snails with shell heights of 10 mm. and under, while the two larger shells represented less than 1% of the medium and larger sized specimens. Apparently the reversed spiral anomaly occurs more frequently than one might assume from the literature. Possibly related morphological or physiological abnormalities bring about a high degree of mortality among these individuals before they reach adult size. —DAVID BICKEL, The Potamological Institute, University of Louisville, Louisville, Kentucky.

AUTUMN MIGRATION OF *HELISOMA TRIVOLVIS* IN MONTANA. — Frequent observations were made of a population of *Helisoma trivolvis* (Say) in a roadside pond one mile south of Frenchtown near Missoula, Montana, during the summer and autumn of 1964. The pond is approximately 100 feet long, 10 to 25 feet wide, and slopes sharply from the edges to a depth of nearly six feet in the center. The bottom material along the edges consists of rocks and gravel mostly covered by leaves and fallen branches. Mud and debris covers the deeper sections. At the inlet, which has an autumn flow of approximately 1.5 cubic feet per second, the pond is only a few inches deep and the substrata consists of coarse sand.

During the summer the snail population was concentrated mainly about the periphery of the pond from the surface to a depth of 3 or 4 feet with most specimens one-half to one foot under the surface. Approximately 25 specimens could be collected in an hour of search about the periphery. Few specimens were found near the inlet either on the surface or under the sand.

During October the population seemed to disappear. Very few snails could be collected from the periphery or could be seen on the bottom at deeper levels. Dredging of the bottom at several deeper points in the pond failed to provide living snails although numerous empty shells were recovered. However, dredging to a depth of one or two inches in the coarse sand in a longitudinally

oriented oval area of approximately four square yards in the center of flow at the inlet provided nearly 250 specimens in less than 10 minutes.

Apparently the snails had aggregated at the pond inlet, possibly to receive protection from freezing or to take advantage of maximum oxygen tensions during the winter or both. In 1934, Chaetum (Trans. Amer. Micr. Soc. 53 (4), 348-407) reported an annual migration of *Helisoma trivolvis* to the surface in spring and summer and to deep water in autumn and winter. But a marked autumn migration and burial in sand at a specific point near the inlet of a pond seems not to have been previously reported. —W. B. ROWAN, University of Montana Dept. of Zoology, Missoula, 59801.

TED NIELSON of Hamilton, Bermuda, a well-known collector, died on June 29, 1965. He was born September 16, 1928. He is survived by his wife, Elizabeth. —R. T. A.

NAPLES SHELL SHOW. — This will be held Feb. 18 to 20, in the Woman's Club auditorium. Before Feb. 1, application for entry may be made to its chairman, Jack G. Messmer, 672 - 16th Avenue, South, Naples, Florida 33940.

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DEVOTED TO THE INTERESTS OF CONCHOLOGISTS

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SIZE OF PELECYPODS IN RECENT MARINE FAUNAS

By DAVID NICOL

Department of Geology, University of Florida, Gainesville

In a previous paper (1964, p. 968) the writer made the following statement:

Small species (less than 10.0 mm. in either height or length) are unusually numerous in the antarctic pelecypod fauna.

The purpose of this paper is to show in some detail the size of pelecypods in 14 living Antarctic faunas and to compare these with the arctic shallow-water pelecypod fauna and cool- and warm-water bivalve faunas as well.

Paleoecologists have become interested in fossil assemblages containing an unusual abundance of small specimens (stunted faunas) or such an uncommon assemblage as the *Eurydesma* fauna of Early Permian age which is almost completely restricted to the southern hemisphere. *Eurydesma* is a large pelecypod with a thick shell, but other animals preserved along with *Eurydesma* tend to be stunted (see Ager, 1963, pp. 290-291). In the case of stunted faunas, paleoecologists have attempted to explain these occurrences by mechanical sorting, lack of oxygen on the sea floor, reduction of salinity, and other causes. (For an excellent recent review of this topic, see Hallam, 1965). On the other hand, zoologists seem not to have shown such great interest in this matter. Furthermore, basic data on recent marine pelecypod faunas is surprisingly sparse. Few faunal monographs have a thorough enough coverage of both large and small-sized species to be useful for analysis. Two additional difficulties are encountered when one looks for adequate data to analyze. If shell measurements are given at all, they frequently are not given in the metric system in books written in English. More commonly still, there is no indication whether the measurements are those of an average-sized specimen or of the largest-sized specimen present. For this paper the writer has taken maximum size (either height or length) in every case where it is given. Of the 14 faunas analyzed, I have included 2 which may not have adequate cov-

erage of the small-sized species, namely the tropical west African and the Japanese. The Teredinidae were not included in the faunal analyses because of the difficulty of measuring specimens belonging to that family. Fresh-water pelecypods were, of course, also excluded.

The data were taken from the following sources. The Antarctic sample was taken from the collections at the U. S. National Museum, which number about 2,550 specimens allocated to 36 species. This number of species must be at least one-half of all of the pelecypods found in shallow water (less than 1,829 m) in the entire antarctic region and should be an adequate sample for analysis. The data for the 13 other faunas were taken from the following works: Point Barrow, Alaska, (MacGinitie, 1959); east Greenland (Ockelmann, 1958); Iceland (Madsen, 1949); New Zealand (Suter, 1913-15); South Australia (Cotton and Godfrey, 1938); California Province, i.e., west coast of North America exclusive of Alaska (Oldroyd, 1924); western Florida (Perry and Schwengel, 1955); Puerto Rico (McLean, 1951); northern Panamic (Keen, 1958); southern Panamic (Olsson, 1961); tropical west Africa (Nicklès, 1950); Morocco (Pasteur-Humbert, 1962); Japan (Taki, 1951).

Table 1 is a summary of the basic data analyzed by the writer, and certain inferences can be made from it. Pelecypods living in the cold (no more than 5° C maximum temperature) shallow waters of the arctic and antarctic regions almost never attain a maximum height or length of more than 100.0 mm. The number of species attaining a greater size than 100.0 mm in temperate and warm sea water commonly amounts to about 5 per cent of the total fauna, and it may be even greater than this in truly tropical faunas. The mean shell size of all of the antarctic species is considerably smaller than that of even the east Greenland fauna, and mean shell sizes are commonly smaller in the colder water faunas than in the warmer water faunas. The antarctic fauna clearly has the largest percentage of small species. In compiling the data on this fauna, the writer took the maximum length or height of each species studied so that the data certainly cannot be considered biased toward small shell size. If only average size of each of the 36 species of antarctic pelecypods had been used, the small size of the antarctic species would have been

Table 1.--Number of pelecypod species in each fauna; mean and maximum sizes in mm; and percentage of species of not more than 10.0 mm, 10.1 to 20.0 mm, and more than 100.0 mm.

Region	N	Mean	Max	%1-10mm	%10.1-20mm	%>100mm
Antarctic	36	16.9	90.0	61.0	19.0	0
Point Barrow	36	34.2	80.0	14.0	14.0	0
East Greenland	56	26.3	100.0	28.5	17.8	0
Iceland	87	31.8	160.0	29.9	20.7	5.9
New Zealand	180	33.5	230.0	32.2	15.6	4.5
South Australia	312	27.4	280.0	37.5	19.2	4.8
Californian	317	35.6	240.0	24.4	18.5	5.3
Western Florida	152	38.6	260.0	14.5	26.3	5.9
Puerto Rico	206	36.6	220.0	18.9	19.9	3.5
Northern Panamic	558	39.5	290.0	12.7	17.9	5.4
Southern Panamic	483	43.3	550.0	12.6	14.1	5.1
Morocco	164	43.4	300.0	12.8	18.9	6.1
West Africa	157	54.4	450.0	8.9	10.2	7.6
Japan	330	70.1	420.0	2.4	7.6	13.2

even more striking. Sixty-seven per cent of the antarctic species do not average more than 10.0 mm in height or length and 83 per cent of the species do not attain an average size of more than 20.0 mm. in height or length. Furthermore, even the South Australian and New Zealand pelecypod faunas have an uncommonly large number of species of small size considering the relatively warm temperature of the waters in these regions. Can this be explained merely by the greater attention that Australian and New Zealand malacologists have paid to the small-sized pelecypods in those faunas? The writer doubts that this is a completely satisfactory explanation for the relatively high percentage of small species in South Australian and New Zealand waters. In the case of these three faunas in the southern hemisphere, there is an unusually large number of species belonging to some genera and families that never attain a large size anywhere in their geographic range. The philobryids and cyamiids are common and

diverse in a large part of the southern hemisphere but are rare or absent in the northern hemisphere. This appears to be the major factor in the large number of small-sized species in these faunas, although it is true, for example, that the one species of *Astarte* found in the antarctic is less than 10.0 mm in size, but the several species of *Astarte* in the arctic all attain a maximum size of more than 10.0 mm.

Noted also from a study of Table 1 is that in the cold or temperate waters of both northern and southern hemispheres there are at least as many species in these faunas that are in the size range from 1.0 to 10.0 mm. as in the size range from 10.1 to 20.0 mm. The reverse is true for the warm-water pelecypod faunas. In this regard, the South Australian pelecypod fauna would be classed with the temperate ones.

The antarctic pelecypod fauna cannot be considered a stunted one in the strict sense because paleoecologists have consistently attributed direct physical causes to the stunted fossil faunas. If there is a physical cause to explain the large number of small-sized pelecypods in this fauna, it is not readily apparent. Even if one or more physical causes are found, they must be linked with genetic factors in this instance because so many of the small-sized species belong to genera and families whose species nowhere attain a large size.

Because of the inadequacy of the basic data which are summarized in Table 1, the writer does not feel justified in attempting any additional inferences.

This research was supported by a grant (G-13335) from the National Science Foundation.

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OCCURRENCE AND DISTRIBUTION OF ASIATIC CLAM, *CORBICULA LEANA*, IN PEARL RIVER, LOUISIANA

BY GERALD E. GUNNING AND ROYAL D. SUTTKUS
Department of Biology, Tulane University, New Orleans, La.

The Asiatic clam, *Corbicula*, was originally introduced into the United States several years ago. Pennak (1953) reported that *Corbicula fluminea* (Müller) was occasionally found in sloughs and rivers of Washington, Oregon, and California. Ingram (1959) summarized the known distribution of the Asiatic clam. Sinclair and Ingram (1961) reported the presence of *Corbicula* in the Tennessee River and Sinclair and Isom published a life

history (1961) and an additional study two years later (1963). Keup, Horning, and Ingram (1963) extended the range of the Asiatic clam to the Cincinnati reach of the Ohio River.

Early in 1964, one of us (G.E.G.) examined an invertebrate collection taken by the writers from the Pearl River just above the entrance of Coburn Creek, near Bogalusa, Louisiana. Using Pennak's (1953) key to families and genera of Pelecypoda (p. 707), 32 specimens were tentatively identified as *Corbicula fluminea* (Müller). Five of the 32 specimens were sent to Dr. J. P. E. Morrison of the United States National Museum who informed us that the determination was correct according to the literature, but that the literature available at the moment was incomplete. Dr. Morrison stated that our specimens should be referred to *Corbicula leana* Prime (personal communication; March 26, 1964).

Extensive collections of benthic invertebrates have been made on the Pearl River. The purpose of this paper is to show the rapid rate of dispersal and increase in numbers that *Corbicula* has undergone during a one-year period.

Methods. Small pelecypods were collected incidental to the collection of fishes using a ten-foot, $\frac{1}{8}$ inch mesh seine. Additional samples were taken by hand-picking or sorting through bottom materials. Although the samples are not strictly quantitative, we attempted to apply equal collecting effort at each station so that they would at least be reasonably comparable.

All valve measurements were made to the nearest 0.5 millimeter.

Results. Table 1 shows the number of specimens of *Corbicula leana* taken at each station during two consecutive years. Evidently *Corbicula* is spreading into new areas within the river system and concomitantly increasing in numbers. Large collections were taken at stations 1, 2, 4 and 7 during 1964; no specimens were taken at these stations during 1963.

Table 2 contains the size distribution of a number of collections made during 1963 at other stations along the Pearl River. The smallest specimen collected measured 4.0 mm total length; the largest specimen in this series of collections measured 28.0 mm total length, although larger specimens were taken elsewhere.

We believe that *Corbicula* invaded the Pearl River during

Table 1. Stations and number of specimens of Corbicula leana taken during two consecutive years of collecting on the Pearl River, Louisiana.

Station	Location	Number of Specimens	
		1963 (Sept.)	1964 (Aug.-Sept.)
1	Mile 59	0	95
2	Mile 54.4	0	324
3	Mile 52.0	4	51
4	Mile 47.0	0	141
5	Mile 46.0	47	413
6	2.0 miles below Wilson's Slough, West Pearl River	9	35
7	4.0 miles below Wilson's Slough, West Pearl River	0	154
8	Near Mile 27.0; West Pearl River	1	2
9	1.5 miles north of town of Pearl River; West Pearl River	1	2
10	Lower End of Nancy's Reach; East Pearl River	<u>2</u>	<u>432</u>
Totals		64	1649

Table 2. Maximum valve length in millimeters, anterior to posterior, for selected collections of Corbicula leana taken from the Pearl River, Louisiana, during 1963.

Station	Location	Number of Specimens	Mean Length	Range	Standard Deviation
A	Pearl River below Highway 10 crossing; Bogalusa, Louisiana	134	14.0	6.0-23.5	2.0
B	1/2 mile below Station A	27	9.0	4.0-22.0	4.0
C	Mile 52.0	7	14.0	9.5-18.0	3.0
D	Mile 46.0	40	16.0	6.5-28.0	6.0
E	2.0 miles below junction of Wilson's Slough; West Pearl River	9	11.0	7.0-18.5	4.0

1959. One group of specimens taken in 1963 centered around 8.0 mm total length; a second group centered around 14.0 mm total length; a third group centered around 22.0 mm total length; the fourth group centered around 34.0 mm total length. This size-class distribution would indicate four year-classes during 1963: 1959, 1960, 1961, and 1962. Keup, Horning, and Ingram

(1963) reported three year-classes for *Corbicula fluminea* in the Ohio River; it was their opinion that *Corbicula* invaded the Ohio River about 1960.

The largest *Corbicula leana* taken in the Pearl River measured 37.0 mm total length; this specimen was assigned to the 1959 year class.

Discussion. The Asiatic clam is rapidly extending its range in the United States. The presence of this species in large numbers in the Pearl River of Louisiana was an unexpected find. Apparently *Corbicula leana* is rapidly spreading throughout the Pearl River system as indicated by its abundance in collections made during two successive years. Specimens were found to be abundant in sand, gravel, silt, and mixtures of these.

Collections are being made on a continuing basis and hopefully additional work will add to our knowledge of the ecology of this form.

Acknowledgment. Messrs. James Reed, Clyde Barbour, Jerome Shireman, and John Ramsey aided during this study.

The work was supported by grants from the National Science Foundation (GB-2420) and National Institutes of Health (WP-00082-05).

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SOME LAND SNAIL RECORDS FROM ARKANSAS AND OKLAHOMA

BY LESLIE HUBRICHT

During the spring of 1965 the author spent two weeks collecting land snails in western Arkansas and eastern Oklahoma. Some of the more interesting species found are reported here.

Mesodon clenchi (Rehder).

Arkansas: Izard Co.: White River bluff, 1 mile below Calico Rock. Yell Co.: rock slide, near the falls, Mt. Nebo.

At the type locality they were found living under ledges. On Mt. Nebo several dead shells were found around the edge of a rock slide. One would probably have to go out at night after a rain to find living ones.

Mesodon edentatus (Sampson).

Oklahoma: Sequoyah Co.: upland mixed woods, 2 miles northeast of Short.

Guppya sterkii (Dall).

Oklahoma: Sequoyah Co.: Polecat Creek bluff, 1 mile southwest of Nicut.

Glyphyalinia lewisiana (Clapp).

Arkansas: Izard Co.: under rock, cedar glade, 4 miles northeast of Calico Rock.

This is another southern Appalachian species which was able to reach the Ozark Region through the Pleistocene corridor across southern Mississippi and northern Louisiana.

Glyphyalinia solida (H. B. Baker).

Arkansas: Saline, Scott, Sharp. Oklahoma: Latimer, Pushmataha.

Mesomphix capnodes (W. G. Binney).

Arkansas: Baxter, Benton, Conway, Independence, Logan, Montgomery, Newton, Polk, Pulaski, Scott, Van Buren, Yell. Oklahoma: Cherokee, Le Flore.

Paravitrea significans (Bland).

Arkansas: Baxter, Benton, Lawrence, Polk, Searcy, Yell. Oklahoma: Atoka, Cherokee, Delaware, Latimer, Mayes, Sequoyah.

Paravitrea simpsoni (Pilsbry).

Arkansas: Boone, Carroll, Newton, Van Buren. Oklahoma: Cherokee, Latimer, Le Flore, Mayes, Pittsburg, Pushmataha.

Discus patulus edentulus Hubricht.

Oklahoma: Sequoyah Co.: Polecat Creek bluff, 1 mile southwest of Nicut.

Helicodiscus notius notius Hubricht.

Arkansas: Benton, Carroll, Conway, Logan, Montgomery, Polk, Scott, Sharp, Yell. Oklahoma: Adair, Cherokee, Mayes, Rogers, Sequoyah.

Helicodiscus jacksoni Hubricht.

Oklahoma: Mayes Co.: rocky wooded hillside, 5.5 miles west of Locust Grove.

This is the first time I have found this species alive. The animal is pure white.

Pallifera marmorea Pilsbry.

Arkansas: Benton, Carroll, Columbia, Logan, Polk, Scott, Sharp, Stone. Oklahoma: Atoka, Cherokee, Latimer, Le Flore, Mayes, Sequoyah.

Catinella oklahomarum (Webb).

Arkansas: Logan Co.: southside of Short Mtn., 2 miles northwest of Paris; Cameron Bluff, Magazine Mtn. Oklahoma: Sequoyah Co.: upland mixed woods, 2 miles northeast of Short.

Strobilops aenea Pilsbry.

Arkansas: Baxter, Benton, Logan, Montgomery, Polk, Sharp. Oklahoma: Cherokee, Le Flore, Mayes, Sequoyah.

My specimens from Magazine Mtn. are typical *S. aenea*. I have seen no *S. aenea* which fit Pilsbry's description and figures of *S. aenea spiralis*. The form of *S. texasiana* Pilsbry & Ferriss found in Oklahoma fits it better than anything I have seen.

Pomatiopsis lapidaria (Say).

Oklahoma: Delaware Co.: near Dripping Springs, 3 miles southeast of Flint.

AN 1870 COLLECTION OF MUSSELS FROM THE CALUMET RIVER, ILLINOIS

BY LOWELL L. GETZ
University of Connecticut, Storrs

A collection of fresh water mussels taken from the Calumet River, Illinois, 21 September, 1870, has recently been discovered among the mollusk collections of the University of Connecticut. These specimens were obtained by the late Dr. Benjamin F.

Koons, but apparently had not been curated or reported. The specimens have the locality ("Calumet River, Illinois") written on the valves. All the shells were wrapped and tied in 1870 Chicago, Illinois newspapers. From all appearances the specimens had not been worked with from the time they were packed. Since no catalog was associated with the specimens, the original collector is not known. The exact locality of the collecting site was not given. Only 8 miles of the river occur in Illinois, however.

The only published account of mussels from the Calumet River is that of Baker (1902). He listed 7 species from the river. The present collection includes 7 additional species not recorded by Baker. The Calumet River is in an area of special importance in interpretations of post-Pleistocene changes in faunal patterns (Walker, 1913). This river is now so highly polluted that the original fauna is greatly disturbed and most species probably eliminated (W. J. Harth, personal communication). Therefore, it seems desirable to place on record the additional species to describe more completely the original mussel fauna of the Calumet River.

The following species and number of specimens are present in the 1870 collection (those marked with an asterisk have not been previously reported from the Calumet River):

Unioninae:

- **Amblema costata* Raf., 6.
- Elliptio dilatatus* (Raf.), 27.
- **Fusconaia flava* (Raf.), 41½.
- **Pleurobema cordatum coccineum* (Conrad), 1.
- Quadrula pustulosa* (Lea), 7.
- **Quadrula quadrula* Raf., 5.

Anodontinae:

- **Lasmigona costata* (Raf.), 1.
- **Strophitus rugosus* (Swainson), 4.

Lampsilinae:

- **Lampsilis siliquioidea* (Barnes), ½.
- Obliquaria reflexa* Raf., 1.
- Truncilla truncata* Raf., 5.

Baker (1902) records the following additional species from the Calumet River:

- Quadrula trigona* [= *Fusconaia undata* (Barnes)].
- Quadrula verrucosa* [= *Tritogonia verrucosa* (Say)].
- Anodonta grandis* Say.
- Lampsilis alatus* [= *Proptera alata* (Say)].

Plagiola donaciformis [= *Truncilla donaciformis* (Lea)].

I wish to thank Dr. L. R. Penner for making available the collection. Dr. H. van der Schalie assisted in identification of the material.

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KELAART'S CEYLON OPISTHOBRANCH SPECIES

BY HENRY D. RUSSELL

Since the time (1858) that Dr. E. F. Kelaart, staff surgeon, first published his Ceylonese species of nudibranchiate mollusca, a certain amount of confusion as to the original publication dates has existed. The reason for this is that his work was re-published several times with only slight title or species name spelling changes, and some of these reprintings are very difficult to obtain. Much of the confusion in regard to these species has been dispelled by the excellent discussions of Kelaart's work by Sir Charles Eliot in 1906 and C. H. O'Donoghue in 1933 (see bibliography). The latter, however, states p. 226 that "in spite of this (studies by Eliot of Kelaart's colored drawings and a number of his actual specimens) however, a good deal remains to be done, and it is to be hoped that, in view of their importance from the systematic and taxonomic points of view someone who has access to the type localities and the same collecting grounds will make an effort to rediscover and describe in satisfactory detail the forms originally described by Kelaart." This work of Kelaart in Ceylon is important not only because it is of a pioneer nature and includes 63 species, but also because it appears in those critical and difficult years for obtaining species references between the termination of the "Index Animalium" by C. D. Sherborn (1850) and the start of the "Zoological Record" (1864). It is also important as being the earliest account of Opisthobranchs from Ceylon and among the earliest on Indo-Pacific forms. The author wishes to acknowledge the assistance of Mr. S. Peter Dance, Section of Mollusca of the British Museum in supplying him with a reproduction of Kelaart's paper in

Journ. Roy. Asiatic Soc. 3, 1858.

The purpose of the present paper is to list, with original references, dates, pages and localities, Kelaart's "new" Ceylonese species of Opisthobranchiata since, to the author's knowledge, no such concise compilation exists. The species are all from the environs of Trincomalie, Ceylon. Only more detailed localities are so stated. The numbers after the species names refer to pages.

The Annals and Magazine of Natural History (3) 1 (4): 257, 258 April, 1858. *Trevelyana*-257 (N. gen.). *T. Ceylonica*-257, Sober Id.

Journal of the Royal Asiatic Society of Great Britain and Ireland, Ceylon Branch, Colombo 3 (1): 84-139 with 2 unnumbered plates, May, 1858.

Doris gloriosa, 91, Fort Frederick. *D. macCarthyi*, 93. *D. caelestis*, 94, Back Bay. *D. funebris*, 94. *D. glenieii*, 95, Cottair. *D. leoparda*, 96, Dutch Bay. *D. amabilis*, 96. *D. fidelis*, 97. *D. preciosa*, 98. *D. nivea*, 98. *D. marmorata*, 99, Fort Frederick.

Doris cerisa, 99. *D. rufopunctata*, 100. *D. grisea*, 100, Fort Frederick. *D. papillosa*, 101. *D. rubra*, 101. *D. osseosa*, 102. *D. constantia*, 102. *D. luteola*, 103. *D. viperina*, 103, French Battery. *D. atrata*, 103. *D. atroviridis*, 104. *D. variabilis*, 105, Dutch Bay. *D. exanthemata*, 105. *D. carbunculosa*, 106. *D. intecta*, 107. *D. lanuginosa* - 107, Nicholson's Cove. *D. spongiosa*, 108. *D. striata*, 108, Dutch Bay. *D. corrugata*, 109. *D. picta*, 109. *D. bellicosa*, 109. *D. castanea*, 110, Sober Id.

Meliboea viridis, 113. *Scyllaea* (?) *dracaena*, 113. *Polycera* (?) *ceylonica*, 114. *Eolis husseyi*, 115. *E. bicolor*, 115, Back Bay. *E. effulgens*, 116, Dutch Bay. *E. paulinae*, 116. *E. tristis*, 117. *E. nodulosa*, 117. *E. smedleyi*, 117.

Proctonotus orientalis, 118. *Pterochilus viridis*, 118. *Elysia grandifolia*, 119. *E. punctata*, 119. *E. caerulea*, 120. *Phyllidia zeylanicus*, 120. *Diphyllidia formosa*, 121. *Pleurobranchus zeylanicus*, 123. *P. purpureus* - 123.

Ann. and Mag. Nat. Hist. (3) 4: 267-270 Oct., 1859.

Doris elizabethina, 267, Aripo. *D. diardi* - 267, Aripo. *D. lockyerana*, 268, Aripo. *D. tennentana*, 268, Cheval Paar Pearl Banks. *D. ariponensis*, 268, Aripo. *D. humberti*, 268, Aripo. *Diphyllidia marmorata*, 269, Aripo. *Bornella hancockana*, 269, Ceylon. *Eolis skinneri* - 270, Fort of Colombo.

A list of Kelaart's publications and republications appears below. Only the three references shown above, however, contain the original species descriptions though the others, because of duplication, appear to also. The reader is referred to C. H. O'Donoghue *Proc. Malacol. Soc. London* 20 (4): 221-226, 1933 for a more detailed discussion of each.

1. Description of a new Ceylonese Nudibranch. *Ann. and Mag. Nat. Hist.* (3) 1 (4): 257, 258, pl. 10B, figs. 1, 2, April, 1858.

2. Description of new and little known species of Ceylon Nudibranchiate Mollusca and Zoophytes. *Journ. Roy. Asiatic Soc. Ceylon Branch, Colombo* 3 (1): 84-139 with 2 unnumbered plates, May 8, 1858.

3. Descriptions of new and little known species of Ceylonese nudibranchiate mollusks. *Ann. and Mag. Nat. Hist.* (3) 3: 291-304, April, 1859.

4. Description of new and little known species of Ceylonese nudibranchiate mollusks. *Ann. and Mag. Nat. Hist.* (3) 3: 488-496, June, 1859.

5. On some additional species of nudibranchiate mollusks from Ceylon. *Ann. and Mag. Nat. Hist.* (3) 4: 267-270, Oct. 1857, 1859?

6. Pamphlet p. 1-64 "Trincomalie" 1st. November 1857, 1959? (This pamphlet was not available to the public and does not constitute a publication according to O'Donoghue *Proc. Malacol. Soc. London* 20: 226, 1933.) It carries the title "Description of new and little known species of Ceylon nudibranchiate molluscs and zoophytes."

7. New and little known species of Ceylon nudibranchiate molluscs and zoophytes. *Journ. Roy. Asiatic Soc. Ceylon Branch*, 1856-61 3 (9): 76-125, 1883.

8. Description of new and little-known species of Ceylon nudibranchiate molluscs, and zoophytes. *Journ. Roy. Asiatic Soc. Ceylon Branch. Colombo* 3 (title only in table of contents in the volume — see O'Donoghue l. c. p. 224, 1933).

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O'Donoghue, C. H. Kelaart's work on the Nudibranchiata of Ceylon. *Proc. Malacol. Soc. London* 20: (4): 221-226, 1933.



Figure 1. Adult *Lyonsia hyalina*. Top row: Living clams. The one at left and the one at right have siphons extended. Bottom row: Exterior view of empty valves at left. Interior view of empty valves at right.

LARVAL DEVELOPMENT OF THE PELECYPOD *LYONSIA HYALINA*¹

By P. CHANLEY AND M. CASTAGNA

Virginia Institute of Marine Science, Wachapreague, Va.

Lyonsia hyalina (Conrad) is a small ($\frac{1}{2}$ to $\frac{3}{4}$ inch) odd-shaped clam (Fig. 1) common along the Atlantic Coast from Nova Scotia to South Carolina (Abbott, 1954). It is usually found in sand in shallow water with a coating of small sand grains attached to the periostracum.

The only published description of larval Lyonsiidae is a tentative identification of *Lyonsia norvegica* (Gmelin) found in plankton samples (Rees, 1950). Rees also tentatively identified larvae of *Thracia* sp., and *Cochlodesma praetenue*. These species belong to closely related families and are grouped with the

¹ Contribution No. 203 from Virginia Institute of Marine Science.

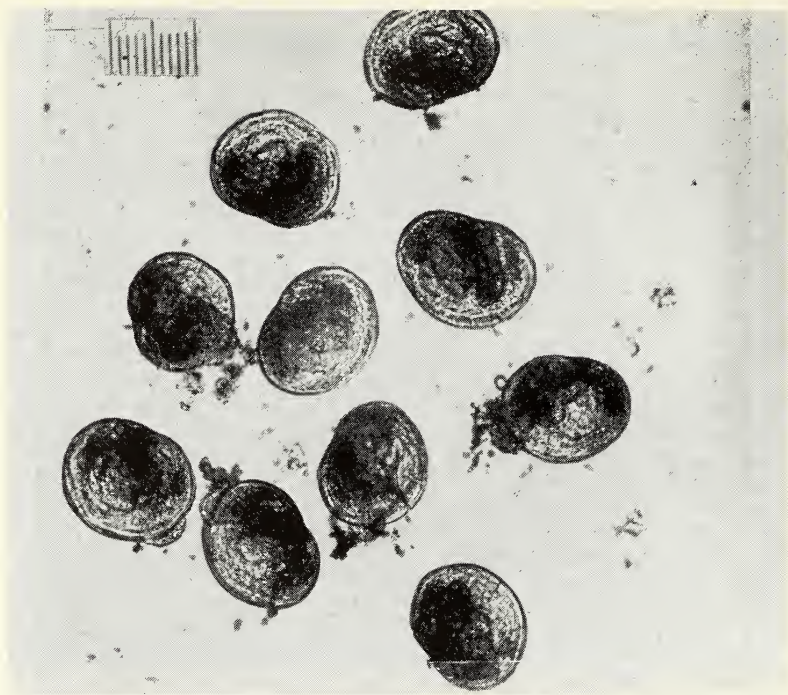


Figure 2. Larval *Lyonsia hyalina*. Scale equals 100 microns.

Lyonsiidae in the super-family Pandoracea. They are described by Rees as being slightly inequivalve and having, in each valve, a single long narrow hinge tooth. The hinge teeth are alternate, rather than opposite, and are poorly defined. A small ligament is located at the posterior end of the hinge. Sullivan (1948) describes juvenile *Pandora gouldiana* Dall, another member of the Pandoracea, and from the shape of the prodissoconch shell concludes that metamorphosis occurs when larvae are 235 microns long and 160 microns high. She notes that a "flattened dorsal edge with no projecting umbones" and "almost black viscera" are characteristic. Her photomicrograph of the hinge structure shows the hinge teeth opposite each other. The larva that Stafford (1912) has tentatively identified as the same species, *Chidiophora* (*Pandora*) *gouldiana*, bears no resemblance to Sullivan's account. But, larval *P. inaequivalvis* is similar.

The purpose of this report is to describe the pelagic larvae of

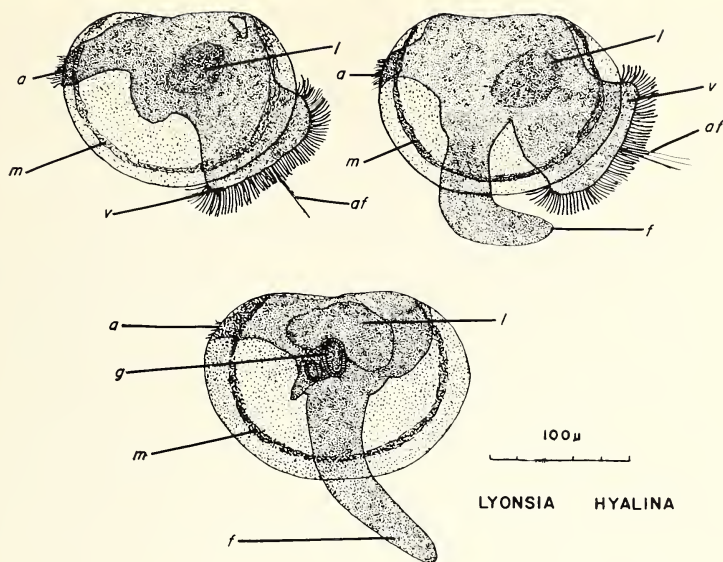


Figure 3. Diagram of major visible anatomical features of larval *Lyonsia hyalina*: a-anus, af-apical flagella, f-foot, g-gills, l-liver or digestive diverticulae, m-mantle edge, v-velum.

L. hyalina so that they can readily be identified in plankton samples. The terms used to describe the larvae are the same as those used for *Barnea truncata* (Chanley, 1965).

Materials and Methods. *L. hyalina* were collected from Mason's Beach on the Chesapeake Bay side of the Eastern Shore Peninsula of Virginia on 1, 8 and 15 April, 1965. Clams were collected by skimming off a layer of sand, near *Zostera* beds, and screening it. On the day following collection, clams were washed in salt water, to remove adhering grains of sand, and placed in finger bowls with filtered or centrifuged salt water. Spawning was induced by increasing water temperature to 24-25° C. Eggs were cultured in 10-liter polyethylene containers and larvae were fed and examined daily. The food consisted of a mixture of *Isochrysis galbana* and *Phaeodactylum tricornutum*. In some cases, clams were isolated in individual polyethylene containers from the time of collection and the gametes from isolated clams were then cultured separately. On one occasion, clams were reared to metamorphosis without the addition of food. All water (at about 20 o/oo) was

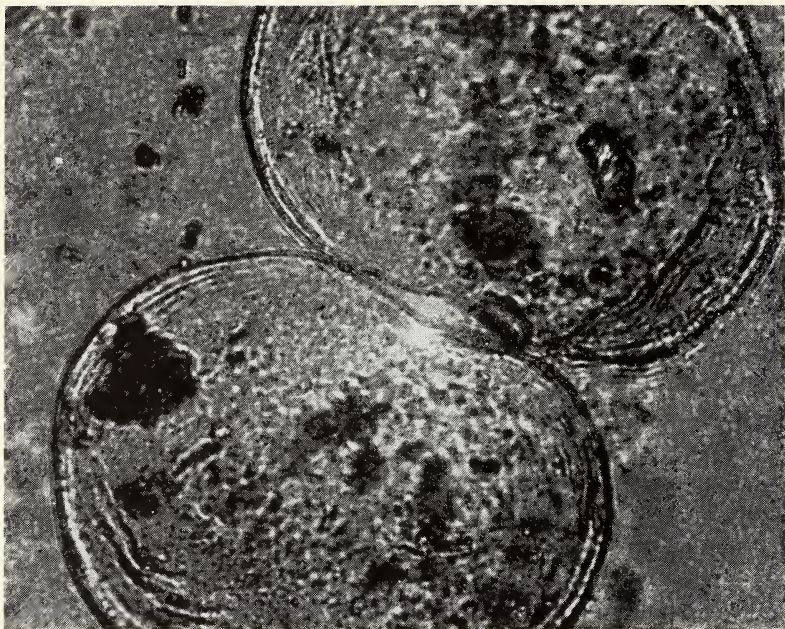


Figure 4. Interior opened valves of *L. hyalina* larvae showing ligament.

either filtered through a one-micron orlon filter or centrifuged by a cream separator. Water temperature of the cultures ranged from 18 to 22° C.

Results. *L. hyalina* released gametes within a few minutes after an increase in water temperature. Eggs were released in a thin stream through the excurrent siphon. They are sand colored and settle quickly to the bottom even after being stirred vigorously. The yolk is large, dark and opaque, measuring 100 to 115 microns in diameter, and surrounded by a lamellate membrane or membranes. The total egg diameter, including membrane, is 160-175 microns. Individual adults released from 8,000 to 16,500 eggs in a single spawning.

The actual release of sperm was not observed. The spermatozoan head is triangular, with blunted angles. It is 3.5 microns long, 2.5 microns wide at the base and has a tail 45-50 microns long.

L. hyalina is functionally hermaphroditic and autofertilization

occurred when individuals were isolated. Larvae obtained from autofertilized eggs developed normally and were reared to metamorphosis. In all spawnings, many eggs did not fertilize or develop normally; however, there was no apparent relation between autofertilization and abnormal development.

Larvae developed to an ovoid "straight hinge" stage 24 hours after fertilization. The hinge line differs from that of most pelecypod larvae in that it is normally slightly indented in the center. The transition from the hinge line to the anterior and posterior slope of the shell is gradual. This results in an oval shape rather than the typical D-shape of most pelecypod straight hinge larvae (Fig. 2). Larvae are dark gray to black and opaque. The internal structure (Fig. 3) is consequently obscured. Usually one to four apical flagella can be seen on the velum.

Larvae range from 155 to 175 microns in length and from 120 to 130 microns in height. Depth is approximately 85 microns. No identifiable hinge teeth are present in the larval shell although a U-shaped ligament 15 microns long and about 11 microns wide extends from one valve to the other (Fig. 4). No appreciable change in shape occurs during the brief larval period and metamorphosis begins in three days. At metamorphosis larvae develop a long ciliated foot, the velum disappears and on the fourth or fifth day, gills begin to develop. Recently metamorphosed individuals attach readily by a byssus thread.

Discussion. Possibly sufficient food occurred naturally in the water to support the development of *L. hyalina* larvae in cultures that were not fed cultured algae. However, the large size of the egg yolk, the small size at metamorphosis and the short pelagic period all suggest that larval requirements for an outside food supply may be negligible.

Larval *L. hyalina* are distinctive and resemble no other known pelecypod larvae except *Pandora gouldiana* (Sullivan, 1948). They can readily be distinguished from the latter by the difference in larval length. *L. hyalina* ranges from 155-175 microns in length while *P. gouldiana* is over 200 microns.

Apparently the tentative identifications of Pandoracea larvae by Stafford (1912) and Rees (1950) are in error since they bear no resemblance to *L. hyalina* or Sullivan's. (1948) *P. gouldiana* in either shape or hinge structure.

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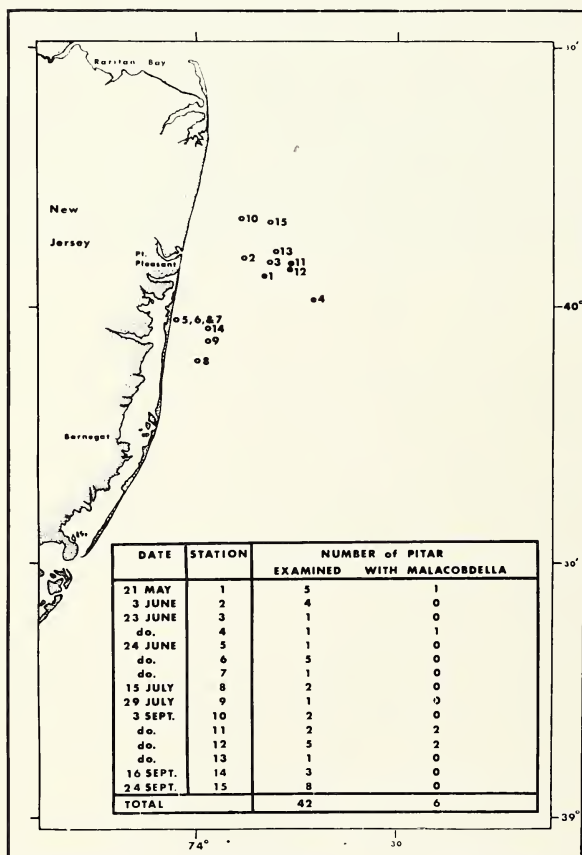


Figure 1. Localities of collection of *Pitar*, and numbers that contained *Malacobdella grossa*, New Jersey coast, 1964.

PITAR MORRHUANA, NEW HOST FOR MALACOBDELLA GROSSA

By JOHN W. ROPES

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The morrhua venus, *Pitar morrhuana* Linsley, has heretofore not been reported as a host bivalve for *Malacobdella grossa* (O. F. Müller), a widely distributed commensal nemertean. Coe (1943) reported 9 pelecypod species on the European coast and two on the Pacific coast as hosts for the nemertean, but none are of the genus *Pitar*. His monograph lists the nemertean as an inhabitant of the mantle cavity of northern quahogs, *Mercenaria mercenaria*, soft-shell clams, *Mya arenaria*, and occasionally American oysters, *Crassostrea virginica*, from the Atlantic coast. A fourth bivalve host along the Atlantic coast was recorded by Porter (1962), who found a very high incidence of *Malacobdella* in southern quahogs, *Mercenaria campechiensis*, off North Carolina. McCaul (1963) listed no additional hosts in recent collections from the marine and estuarine waters of Virginia. The fol-

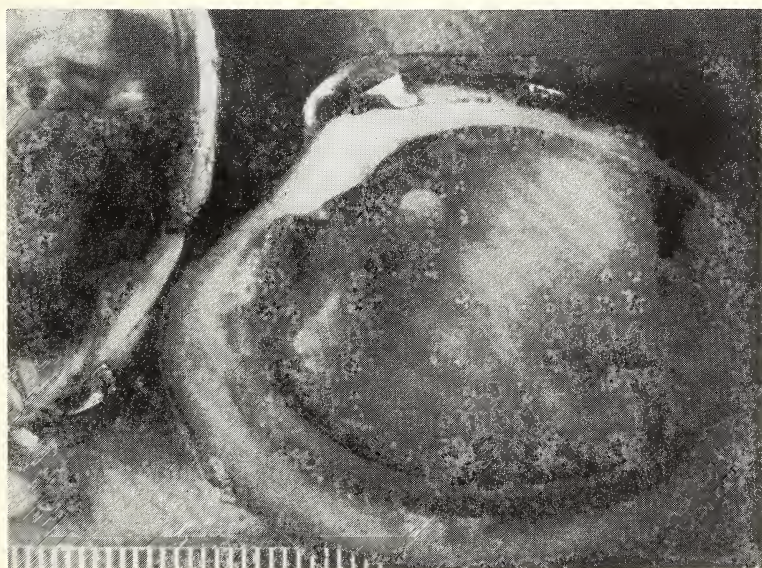


Figure 2. The nemertean *Malacobdella* attached to the mantle of *Pitar*. The scale in the lower left corner of the photograph is in millimeters.

lowing is a record of the fifth bivalve host for *M. grossa* along the northwestern Atlantic coast.

Pitar were obtained in the summer of 1964 from catches by commercial and research vessels fishing for Atlantic surf clams, *Spisula solidissima*, off the New Jersey coast. The commercial hydraulic dredges used take large quantities of live bottom fauna, some bottom sand and mud, and debris in a single tow; a similar dredge was used to collect materials for the study of *Malacobdella* in Nantucket Sound, Mass. (Ropes, 1963). *Pitar* and several other bivalve species were sorted out of the dredge catch from New Jersey. After they were measured and opened, a thorough search was made on the surface of the mantle and body mass. Only *Pitar* contained the nemertean. *M. grossa* occurred in 6 of 42 *Pitar* caught at 15 stations (Fig. 1). The incidence of infection was 14%. Shell-length measurements of the 42 *Pitar* ranged from 32 to 52 mm. and averaged 42 mm.; *Malacobdella* occurred in specimens 33 to 45 mm. long. Several photographs taken within a few minutes after opening the clams showed that the sucking discs of all 6 nemerteans were attached to the mantle (Fig. 2).

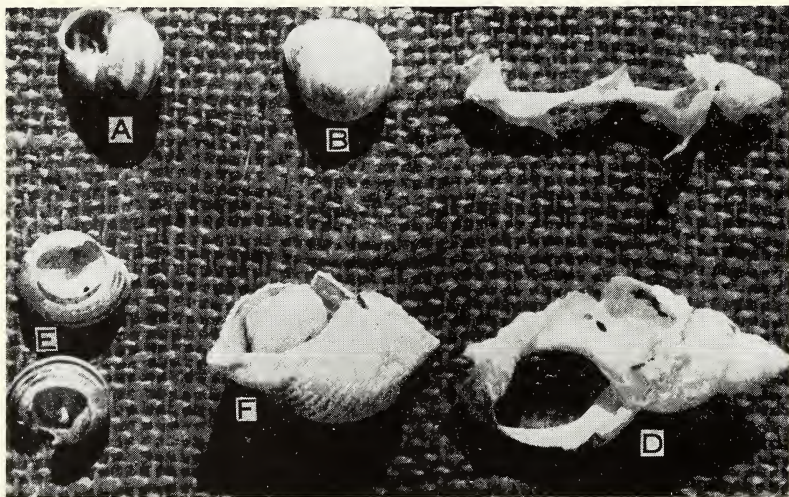


Figure 1. Mollusca from Brier Island, Digby County, Nova Scotia: (a & b) intact shells of *Cepaea hortensis*; (c & d) shells of *Buccinum undatum* fed upon by *C. hortensis*; (e) two *C. hortensis* shells showing where predators have nipped off the spire to extract the snail; (f) dead, bleached *C. hortensis* which grew after feeding inside the *B. undatum* shell and became fatally trapped by the projecting parietal lip of the larger snail.

Each host contained only a single nemertean.

The *Pitar* were dredged from water depths of 40 to 120 ft. (ca. 12.2 to 36.6 m.). Clams containing the nemertean were in depths ranging from 84 to 120 ft. (ca. 25.9 to 36.6 m.).

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BEHAVIOR OF CALCIPHILIC CEPAEA HORTENSIS ON ACIDIC ISLAND OFF NOVA SCOTIA

By J. SHERMAN BLEAKNEY

The occurrence of the common European garden snail, *Cepaea hortensis*, along a thousand miles of coastal islands from Newfoundland to Massachusetts has always puzzled zoogeographers (Walden, 1963, in North Atlantic biota and their history, Pergamon Press). Various theories attempting to explain its distribution have been advanced and are summarized by Walden, but he concludes that the only way to solve the problem of *C. hortensis* is through more field investigations.

One basic ecological problem seems to be the question of the source of lime for these snails on the many acidic islands where the species does occur. Pertinent statements in two standard references were not at all specific and at times even contradictory. For example, in Pilsbry's (1939, Academy Natural Science, Philadelphia, Monograph No. 3, vol. I, part I:8) account of this species, he says of this lime-loving European snail, "In America the species does not appear adapted to conditions inland. As Johnson has pointed out it is a calciphile and our northeastern coast is almost exclusively granitic. The barren coastal islands make up in lime and moisture what they lack in vegetation."

This last puzzling sentence is also found in Johnson (1906, *The Nautilus* 20 (7):80) who credits islands and headlands as being "continually bathed by the ocean spray" and seems to imply that this salt spray is a source of lime. However, land snails have a marked sensitivity to salt exposure (Walden, 1963). In no case do these authors specifically identify the exact nature of the lime consumed by these land snails.

On October 6, 1963, this author observed many *C. hortensis* (fig. 1, a & b) on Brier Island, Digby County, Nova Scotia, feeding upon limy marine shells that gulls had dropped inland beyond the spray zone. In a search of the literature for similar observations, a passage was finally found in Brooks and Brooks (1940, *Annals Carnegie Museum* 25:61) referring to *Vertigo alpestris* (another European snail found by Brooks & Brooks on small islands off Newfoundland) "feeding upon the bleached tests of sea urchins and other limy shells dropped by gulls." Apparently the gull-dropped shells were not identified to species nor were any related observations reported. *C. hortensis* was collected at the same time but no mention was made of it feeding on the marine shells.

Brier Island consists of basalt rock with a basic forest cover of spruce and fir with a few acid bogs. The area reported here is on the northeast side of the island bordering the channel between Brier and Long Islands, and consists of a mixture of grassy fields, boggy ground, blackberries and scattered spruce trees, with a ridge of rock running at an acute angle to the shore. Careful examination was made of this rock outcrop as it was obviously a favorite drop area used by the gulls on which to break open marine shellfish prey. Three species of crabs, *Cancer borealis*, *Cancer irroratus* and *Carcinides meanes* were found, but by far the dominant and only other shell located was that of the marine snail *Buccinum undatum*. The thick limy shells of this snail had accumulated against the sod at the base of the outcrops, and it was here that *C. hortensis* was so abundant and where its labors were evident by the degree to which the thick *B. undatum* shells had been rasped to a paper thin state and even reduced to the central columella (fig. 1, c & d). Evidently the gulls in their efforts to prey upon one species of marine snail were providing a continuing supply of lime for a terrestrial

species in what was otherwise a relatively inhospitable acidic habitat.

As specimens of both *C. hortensis* and *B. undatum* were collected, it was soon noted that other ecological relationships were in effect, and they are presented here in the hope that others may be stimulated to observe more closely the phenomena associated with gull shell-drop sites. The numerous *C. hortensis* snails were rasping the *B. undatum* shells from without and within. Those snails active on the outer surface of the sea shells were exposing themselves to some unknown predator which operated by neatly nipping off the low spire of the *C. hortensis* shells and extracting the snail. Numerous brightly banded but spireless shells were scattered about the area (fig. 1, e). There were small mammal runways in the grass, and possibly some species of shrew or rodent was responsible.

A closer examination of the *B. undatum* shells revealed that many of the *C. hortensis* feeding from the inside were not faring much better. They were well protected from the unknown predator, but many of them had died intact within the marine shells. They had added lime to their own shells to such a degree that they were either wedged in place or could not get past the projecting overhang of the parietal lip of the aperture of the *B. undatum* shells. The rich source of essential lime had soon become the snail's sarcophagus. *C. hortensis* individuals were found in various stages of entrapment: actively moving about within the aperture; wedged immobile within the spirals of the shell (and only exposed when several *B. undatum* shells were ground down on an emery wheel); inactive and their aperture sealed over by an epiphragm; and dead, bleached individuals (fig. 1, f). In one case a small live *C. hortensis* was observed within a larger *hortensis* shell, and even though it could turn around completely within the aperture chamber, it was definitely imprisoned. Possibly some of these trapped snails were eventually released by the combined feeding efforts of other individuals for in several *B. undatum* shells, imprisoned *C. hortensis* could be seen through openings rasped from the outside by other snails.

The writer had hoped to locate other similar areas of *C. hortensis* populations in Nova Scotia, but the opportunity for such field work has not arisen. Therefore, these notes are offered here

in hope of stimulating others to look for this interesting relationship of a terrestrial snail dependent for its lime upon the shells of a marine snail dropped by gulls on rocks beyond the salt spray zone, and of the mortality experienced by the terrestrial snail in its quest for lime through exposure to predators and inadvertent entrapment within the marine shells.

The author is indebted to Dr. R. G. Moore, Acadia University, and Dr. A. H. Clarke, Jr., National Museum of Canada, for assistance in locating valuable references. The field work was greatly facilitated by the collecting efforts of Jill and Peter Bleakney.

MORTALITY AND APERTURAL ORIENTATION IN ALLOGONA PTYCHOPHORA DURING WINTER HIBERNATION IN MONTANA

By W. PATRICK CARNEY

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Land mollusks of the family Polygyridae normally overwinter by hibernation on the surface or in slight depressions in the ground. Commonly, they form a thick and calcareous epiphragm at the opening of the aperture. Binney (1851) noted that orientation with aperture up was common for many land mollusks during winter hibernation. Blinn (1963) found a low mortality in both *Allogona profunda* and *Mesodon thyroideus* during overwintering and commented on the upward apertural orientation in these two species. Foster (1936) working with *M. thyroideus* and Fischer (1950) concerning land snails in general also noted low winter mortality. Field observations with a marked population of *A. ptychophora* in Greenough Park near Missoula showed both upward and downward orientation during winter hibernation. Upward orientation was the most common. To test the significance of this orientation 25 snails were placed aperture down and 139 with their aperture up in a circle 3 feet in diameter during October 1964. The plot was visited throughout the winter and in the following spring when mollusk activity again resumed.

The *A. ptychophora* under study were not disturbed throughout the winter, since the heavy cover of snow remained undisturbed. In the spring the leaves that covered the circular plot were re-

moved. Many of the dead snails had their calcareous epiphragms still intact, while in others it was partially broken. There was no evidence of rodents or shrews having disturbed the plot. The living snails were found radiating out from the circular plot in all directions.

Overall mortality during winter hibernation was approximately 18 per cent. This is in contrast to the comments of Blinn (1963), Foster (1936) and Fischer (1950) who found no significant overwintering mortality for land snails. Furthermore the upward orientation during this period as noted by Blinn (1963) and Binney (1851) appears to be important to survival. A Chi-Square analysis comparing dead snails in apertural up and down positions was significant at the two per cent level indicating that the downward orientation definitely contributes or is at least related to the incidence of winter mortality (Tables 1 and 2).

In addition to the above experiment, a random count of 145 empty shells in an adjacent plot revealed 18 per cent. more to be aperture down.

Why orientation seems to have significance is unknown. Perhaps microbes, nematodes or mites gain access to the host when the epiphragm is in contact with the soil. Further examination might reveal a common etiological agent responsible for the overwintering mortality associated with apertural position.

Since no juveniles were placed aperture down in orientation, the significance of age in relation to orientational was not examined. When apertures faced upward there was no significant difference between adult and juvenile mortality, the former being 20 per cent. and the latter 17 per cent.

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TABLE 1
Position in Fall 1964

	Adults	Juveniles
Aperture up	128	11
Aperture down	25	0
Total snails	153	11

TABLE 2
Condition in Spring 1965

	Adults	Juveniles
Dead snails aperture up	20	2
Dead snails aperture down	9	0
Total dead snails	29	2
Alive snails aperture up	108	9
Alive snails aperture down	16	0
Total alive snails	124	9

NOTES AND NEWS

CORRECTION. — On page 39, vol. 79, no. 2, in the first line of the 4th paragraph, "*Cypraea cicercula* Linn., 1758," should read *Cypraea nucleus* Linn., 1758. — C. M. BURGESS, M.D.

DR. LESLIE REGINALD COX, O.B.E., F.R.S., Sc.D., died on 5th August, 1965, at the age of 67. Between 1922 and 1963 he was Curator of fossil molluscs at the British Museum (Natural History), London, and was appointed Deputy Keeper of the Palaeontology Department in 1961. Since his retirement he still worked almost full-time and was in the Museum the day before his death.

He served in the Royal Navy during the first World War and was badly wounded in the raid on Zeebrugge harbour in 1918. He won a scholarship to Queens' College, Cambridge, where he gained a double first. Most of his 160 publications were concerned with Mesozoic faunas from many parts of the world. Latterly, he was a major contributor to the *Treatise on Invertebrate Paleontology*. He had been a corresponding member of the American Museum of Natural History and the Paleontological Society.

In 1925 he married Miss Hilda Lewis and they have a son and daughter.

A more extensive obituary, probably including a bibliography, will appear in the *Proceedings of the Malacological Society of London*.

CELETAIA, NEW GENUS OF VIVIPARIDAE FROM THE ISLAND OF CELEBES, INDONESIA. — In the course of research on the family Viviparidae for the Treatise on Invertebrate Paleontology, the need for a new genus to include a very distinct species of viviparid from Lake Posso, Island of Celebes became apparent.

In 1898, Paul and Fritz Sarasin published a report upon the fresh-water mollusks of the island of Celebes in Indonesia. Four new species of *Viviparus* were described, three of which were typical viviparids; the fourth, *V. persculptus*, appears to be generically distinct. Upon shell characters alone this new genus is distinctly related to certain elements in southeast Asia, such as the *Taia* complex.

Description: Shell medium in size, extended, minutely umbilicate, with convex and shouldered whorls. Colored a dark brown both inside and outside of the shell. Aperture subcircular. Sculptured with 5 to 6 heavy spiral lirae on the whorl below the shoulder, and with numerous and finer lirae on the base of the shell. Axial sculpture of rather coarse growth lines near the aperture. Operculum subcircular, thin, corneous, with numerous concentric growth lines and an excentric nucleus.

Type species, *Vivipara persculpta* P. and F. Sarasin, 1898, Die Süßwasser-Mollusken von Celebes (Wiesbaden), 1: 62, pl. 10, fig. 129-130; pl. 9, fig. 121. — WILLIAM J. CLENCH.

INTERGLACIAL HENDERSONIA OCCULTA IN CANADA. — Recently, while making identifications of Pleistocene mollusks, the writer discovered a single specimen of *Hendersonia occulta* (Say) in fossiliferous sands from the Don Valley Brickyard in Toronto, Ont. This deposit overlies and channels the Scarborough Beds and underlies the Sunnybrook Till. It is, therefore, probably older than 50,000 years and may be of Sangamon age.

The specimen of *H. occulta* (N.M.C. 15660) is well preserved, measures 4.7 mm. in height and 6.5 mm. in diameter, and is typical of the species in all observable characteristics. It represents a considerable extension in range beyond the closest known neighboring Pleistocene or recent locality (Alleghany Co., Pennsylvania) reported by Pilsbry (1948, Land Mollusca of North America 2 (2):1088) and constitutes the first Quaternary record of a terrestrial archaeogastropod from Canada. The find also

corroborates Pilsbry's speculation. He suggested that since fossil *H. occulta* had apparently been only preserved in loess areas, it probably had a more extensive geographical range than its fossils would indicate.

The writer is grateful to Dr. V. K. Prest, Canada Geological Survey, who collected the sample containing *H. occulta* and to Dr. P. F. Karrow, University of Waterloo, for the opportunity to study this interesting material. — A. H. CLARKE, JR.

CECILIOIDES ACICULA (Müller) in Kutztown, Berks County, Pennsylvania. — One dead specimen (A.N.S.P. 302132) of *Cecilioides acicula* was collected March 28, 1965, at the old Sacony Creek bed, between Normal Avenue and Constitutional Boulevard. It was found under a stone 80 feet from the Blvd., and 15 feet from the creek bed. The species has been found to be very uncommon at this locality. — TERRY L. SINE.

CORBICULA FROM THE MISSISSIPPI RIVER. — A recent report by Parmalee, 1965, Trans. Illinois State Acad. Sci. 58(1): 39-45, 2 figs., confirms the establishment of *Corbicula* throughout the Illinois section of the Ohio River and up the Wabash River at least to White Co., Illinois, although it was not found near Maunie, White Co., New Harmony, Posey Co., Indiana or Grayville, White Co., Illinois by Parmalee in 1964. On August 9, 1963, I collected near Vincennes, Knox Co., Indiana and found no trace of *Corbicula*. No *Corbicula* have been reported from the Mississippi River above Cairo, Illinois. Parmalee collected at 4 stations in 1964 with negative results. From August 4-7, 1963, I collected at 4 miles south of Chester, Randolph Co.; one-half mile south of Grand Tower, Jackson Co.; one-half mile west of Fayetteville, Alexander Co.; and at Fort Defiance with negative results.

The only previous Mississippi River record is Parmalee's find of 3 dead pairs and a live juvenile almost directly below the Illinois-Missouri bridge on the Missouri shore. On August 7, 1963, I collected 10 pairs and one valve at Wickliffe, Ballard Co., Kentucky, but failed to find specimens in the vicinity of ferry landings at Columbus, Hickman Co., Kentucky; Belmont and Dorena, Mississippi Co., Missouri; Hickman, Fulton Co., Kentucky; and Tiptonville, Lake Co., Tennessee. In view of the

great interest concerning the rapid spread of *Corbicula* in the Ohio Valley, it seems worthwhile to record my 1963 negative records together with the single positive Kentucky collection. The latter material is on deposit in Chicago Natural History Museum, catalogue number 123601.

Most authors, including myself, 1962, *Nautilus*, 75 (3): 126, have called these clams *Corbicula fluminea* (Müller). Sinclair & Isom (1963, Further studies on the introduced Asiatic clam *Corbicula* in Tennessee, Tennessee Stream Pollution Control Board, Tennessee Department of Public Health, Nashville, 75 pp., figs., summarize Japanese anatomical and life history studies indicating that the name *fluminea* should be restricted to brackish-water populations and that the introduced freshwater populations should be called *Corbicula manilensis* (Philippi, 1844) (*loc. cit.*, pp. 28-35, 50). The two types are conchologically identical.

Sincere appreciation is extended to Dr. Fritz Haas and Dr. Alan Solem for their assistance. — FREDERICK R. FECHTNER, 2105 Edgebrook Drive, Rockford, Illinois, 61107.

TWO SPECIES OF THE BIVALVE GASTROPOD *BERTHELINIA* FOUND IN PUERTO RICO. — This is the first record of *Berthelinia*, the bivalve gastropod, from Puerto Rico; and to our knowledge, the second record of the genus from the Atlantic. Edmunds (1962, 1963) reported and described *Berthelinia caribbea* from Jamaica. Our search for the bivalve gastropod in Puerto Rico started in 1960, soon after the discovery of the living animal in Japan (Kawaguti & Baba, 1959).

Our first *Berthelinia* specimen (a single valve) was collected on April 18, 1961, while dredging in approximately 15 fathoms, on the west coast of Puerto Rico. Two years of intermittent but diligent collecting of algae and dredging yielded no other specimens of this species.

On November 24, 1964, some 30 specimens of *Berthelinia caribbea* Edmunds were found living on algae, collected by Luís Almodóvar, from mangrove roots at Guayacán Bay, on the south coast of Puerto Rico. The algae from these roots were predominantly *Caulerpa verticilla*, *C. racemosa*, *Acanthophora spicifera*, and *Amphiroa fragilissima*.

The shells of the live specimens ranged in length from 1.5 mm. to 4.0 mm. The largest Puerto Rican shell was slightly larger than the largest shell found in Jamaica but the specimens agreed in every other respect. The habitat was also similar to that in Jamaica. The animals were kept alive in the laboratory for several days so that they could be photographed and their activities observed. The living snail is green with brown speckling on the head, neck, and rhiniphores. The mantle as seen through the transparent shell has many dark brown striations and blotches.

The specimens will be divided and sent to the following institutions: Institute of Marine Biology, Mayagüez, P. R.; Academy of Natural Sciences, Philadelphia; U. S. National Museum; Museum of Comparative Zoology, Harvard; Dept. Geology, Stanford University.

The single valve, collected from deep water opposite the Rincón Lighthouse in 1961, was compared with shells of the live specimens, and proves to be distinct. It also has been compared with the descriptions of previously reported *Berthelinia* and appears to be different from all of them.

The dredged specimen is a left valve, with the helicoid tip plainly visible. The shell is 3.4 mm. in length, 2.3 mm. in height (ventral margin slightly chipped); it is yellowish, translucent, without evident rays; irregular growth lines are prominent on the surface of the shell. As compared to *B. caribbea* the most striking difference is in the spiral nucleus; in *B. caribbea* the nucleus has $1\frac{1}{4}$ whorls and is erect, and in ours it has 2 whorls and is flattened over the hinge margin. Designation of a specific name for the new species, will await the collection of additional material. The present specimen will be deposited at the Academy of Natural Sciences in Philadelphia.

Several persons have cooperated in this search for live *Berthelinia* in Puerto Rico. I wish to express special gratitude to Dr. John E. Randall, Director of the Institute of Marine Biology, who personally SCUBA dove to depths of 60-90 feet to collect algae; to Dr. Luís Almodóvar, who collected large quantities of *Caulerpa* to be examined for the presence of *Berthelinia*; and to my husband, who spared no effort to help with this project. — GERMAINE L. WARMKE, Institute of Marine Biology, University of Puerto Rico, Mayaguez, Puerto Rico.

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EDUARDUS AND LINISA, 1930. — Pilsbry, 1930, *Proc. Acad. Nat. Sci. Philadelphia* 82: 315, proposed the genus-group *Eduardus*, type *Polygyra martensiana* (Pilsbry). In 1956, *Proc. cit.* 108: 20, he added *Erymodon*, "new subgenus," type *P. ventrosula* (Pfeiffer), also from Mexico. Since in the same paper (pp. 30 & 27), he included *P. martensiana* in this group, *Erymodon* seems to be at least a subjective synonym of *Eduardus*, which apparently includes Pilsbry's *P. texasiana* group, 1940, *Acad. Nat. Sci. Philadelphia. Monogr.* 3, vol. 1: 613. In 1930 (*loc. cit.*) he also proposed *Linisa*, type *P. anilis* (Gabb), but in 1956 (*loc. cit.*: 27) added *Solidens* with the same type to its synonymy. Incidentally, Clench & Turner, 1962, *Acad. Nat. Sci. Philadelphia, Spec. Publ.* no. 4, included only the 1956 names. — H. B. B.

UNIONE PEELING. — American shell collectors may be overlooking beautiful native treasures in their own neighborhood. The ones that they most frequently neglect are our plentiful freshwater mussels. Many varieties should merit far more attention from our nation's conchologists.

The first thing the interested collector must do is procure the correct specimens. These may be readily obtained from most of our larger fresh-water streams. Thick shells showing some color are generally better to work on than thin or pure white ones.

Properly seasoning your shells will require a few years. A shaded location on the north or west side of your house is likely the best place. They have been aged enough when you may rather easily flake off some of their bottom of their two other layers with the stout blade of a penknife.

The beauty of these mussels is always a hidden one. Revealing it is often a challenge. Directions for removing the two ugly outer layers that hide it are simple. Take your stout-bladed knife in one hand and firmly grip the shell with the other. Pry off the outer coatings, exposing the inner ones. You may also wish to carve the shell to suit your fancy.

Your best creations could be used for unique plaques. Less lovely ones are always useful as ornaments around your flowers, mixed with seashells, in a special collection of their own, etc. The proper usage could best be shown by the shell itself. No two shells are ever quite the same. — JOHN R. WOEMMEL.

EUGLANDINA ROSEA IN NORTH CAROLINA. — In March, 1965, a former student of mine, Mrs. David Schneider, reported finding a large snail in her back yard in Beaufort, N. C. It turned out to be *Euglandina rosea* (Férussac). Later she found several more. I do not think it has been reported from North Carolina before. Pilsbry (1946) reported the distribution as : La., Miss., Ala., Fla., Ga., and S. Car. — Yemassee. Rehder in 1949 reported finding one young living specimen in Myrtle Beach, S. Car. and noted that this was 130 miles north of the previous record in Yemassee, S. Car. (Some land and freshwater mollusks from the coastal region of Virginia and North and South Carolina. *Naut.* 62: 121). — CHARLOTTE DAWLEY.

FURTHER RECORDS OF CORBICULA FLUMINEA (Müller) in the southern United States. — Recent collecting in the southern watersheds has revealed the colonization of five more Gulf drainages by the introduced Asiatic clam, *Corbicula fluminea*. Amite drainage: Amite River at Port Vincent, Livingston Parish, La. (July 6, 1965). Pearl drainage: Pearl River 1 mi. E of Bogalousa, Washington Parish, La. (July 5, 1965). Pascagoula drainage: Leaf River at McLain, Greene Co., Miss. (July 2, 1965). Conecuh-Escambia drainage: Escambia River 3 mi. E of Century, Escambia Co., Fla. (May 14, 1965). Ochlockonee drainage: Ochlockonee River 11 mi. NW of Tallahassee, Leon Co., Fla. (May 28, 1965).

In addition several upstream extensions in previously reported drainages have been discovered. Yazoo drainage (also see Hubricht, 1964 *Naut.*, 77: 143): Coldwater River 1 mi. E of Marks, Quitman Co., Miss. (July 16, 1965). Alabama River system (also see Hubricht, 1963, *Naut.*, 77: 31; 1965, *Naut.*, 78: 106): Tombigbee River 13 mi. E of Silas, Choctaw Co., Ala. (Nov. 25, 1964). Apalachicola drainage (also see Heard, 1964, *Naut.*, 77: 104): Chipola River 2 mi. E of Clarksville, Calhoun Co., Fla. (May 14, 1965).

Inasmuch as the Cross-Florida Barge Canal is now under construction, before long *C. fluminea* can traverse this man-made confluence from its present occurrence in the Withlacoochee River (see Heard, 1964, Naut., 77: 104) a Gulf drainage, into the St. Johns River drainage which exits into the Atlantic Ocean. — WILLIAM H. HEARD, Florida State University, Tallahassee.

HAPLOTREMA CONCAVUM VS. DEROCERAS GRACILE. — On September 12, 1945, a specimen of *Deroceras gracile* (Rafinesque) was placed in a cage with a specimen of *Haplotrema concavum* (Say). Shortly thereafter the *Deroceras* was noted biting the *H. concavum*, causing it to withdraw into its shell. Subsequently the slow-moving *Haplotrema* was noted trailing the aggressive slug! On an earlier occasion, Sept. 8, 1945, when living *D. gracile* were placed in a cage with 7 *H. concavum*, within 15 minutes, 3 of the *Haplotrema* were feeding on the slugs. During the initial contact by the *H. concavum* the slug was bitten, but was only killed and eaten on the second contact. The attacked slug seemed slowed-up in its actions after being bitten by the *Haplotrema*. It would be desirable for the saliva or freshly extracted radula of *Haplotrema* to be tested for toxicity. Any toxic substance present must not be very potent as I have observed some land-snails to survive being bitten. There is also the possibility of immunities being developed either by individuals or species to any toxic substance released by the attacking *Haplotrema*.

One attack was not in successive stages. The snail's initial attack at the caudal extremity of the slug was continued by its biting and crawling rapidly over the slug's dorsum. In this case the initial attack was lethal, for with its foot, the *Haplotrema* partly enveloped the *Deroceras* and soon completely ingested it. — GLENN R. WEBB, Kutztown State College, Kutztown, Pa.

NEW NORTHERN RECORD FOR PAPYRIDEA MANTAENSIS, Olsson 1961. — One valve of this recently described species (Olsson, Axel A. Panamic-Pacific Pelecypoda, page 250) was collected for me by Dr. Wilbur L. Bullock in May, 1963 at Acapulco, Mexico. Olsson mentions only 5 localities for this species: Bucaro, Panama; Manta and Santa Elena, Ecuador; Zorritos and Mancora, Peru. This additional locality extends the known range about 1300 miles northwest. — ROBERT C. BULLOCK.

CORBICULA MANILENSIS. — Since this often has been misspelled, a trivial correction may be timely. Philippi, 1844, Zeitschr. f. Malak. 1: 162-163, proposed *Cyrena manilensis* from Manila, which is the approved spelling of the Philippine city, even in English. Incidentally, Sherborn, 1940, Index Animalium, 1801-1850: 3851, quoted the name correctly. — H. B. B.

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THE NAUTILUS

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No. 1

MESODESMA ARCTATUM: FOSSIL AND LIVING SPECIMENS ON NANTUCKET

BY JOHN D. DAVIS

Department of Zoology, Smith College

Nantucket Island is one of the few places on the Atlantic Coast where fossil specimens of *Mesodesma arctatum* (Conrad) 1831 can be found near living populations of the clam. In fact, the proximity of these two sources of valves has probably led to mixing of fossil and present day specimens in museum and personal collections. Some references in the literature list Sankaty Head as a collecting site for either living or fossil specimens of *M. arctatum*. In August 1964, I spent a week collecting on Nantucket hoping to determine the present distribution of *M. arctatum* on the Island and to find out, if possible, whether the Sankaty Head area did yield both fossil and living specimens of this bivalve mollusk.

Sankaty Head fossil deposits were first described by Desor (1849). Later discussions included Shaler (1889), Curtis and Woodworth (1899), Wilson (1905, 1906), and Cushman (1906). The deposits were determined to be Post-Tertiary and more specifically described as Pleistocene and Post-glacial. Some disagreement developed on the manner in which the deposits were formed. Curtis and Woodworth (1899), particularly, argued that the material had been moved to the present location from another by ice action. This hypothesis is supported to some extent by the fragmented nature of much of the material.

In August 1964 the following intertidal areas were examined: (1) South Beach at Madaket, from Long Pond west to the new cut on Smith's Point, then one-fourth mile north toward Jackson's Point; (2) One and one-half miles of South Beach eastward from the end of Hummock Pond; (3) South Beach, one-quarter miles each side of bathhouse at Surfside; (4) South Beach, one-half mile east from Tom Nevers Head; (5) Siasconset Beach, from public parking area north nearly two miles; (6) Eastern Beach, five miles from Great Point to Wauwinet; (7) Wauwinet, one-quarter mile of harbor beach; (8) Beach at Pocomo Head; (9) Public beach

area at The Jetties; (10) One-half mile of beach at Dionis. A few shells of *M. arctatum*, obviously recently vacated, were found on Great Point north of the narrow neck known as The Gauls. Similar shells were found more abundantly on South Beach east of Tom Nevers Head, at Surfside, near Cisco and Mioxes Pond and near the end of Hummock Pond Road. In addition, one live specimen, 31 mm. long, was found in the surf at Surfside. Careful collecting did not yield any beach shells of *M. arctatum* at Sankaty Head.

The Sankaty Head fossil deposits were examined on two occasions. Apparently recent beach erosion had sufficiently undermined the banks to cause the surface layers to slide down to the beach, thus exposing again portions of the fossil deposits. The bank in front of the present Sankaty Head Lighthouse was examined up to 30 ft. above the beach. Many shell fragments were found, but few whole valves were unearthed. Only one valve of *M. arctatum* was identified, and I could not detect any stratification of the bank described in earlier accounts.

M. arctatum does not appear to live in the area adjacent to Sankaty Head today. Instead, it is probably most abundant in shoal areas immediately offshore at Great Point, Tom Nevers Head, and between Surfside and Hummock Pond. Each of these areas is the site of a "rip" or shoal extending outward nearly at right angle to the beach line. The rips at Great Point and Surfside [Hummock Pond] are prominent enough to have earned names; the former is known on charts as Point Rip, the latter as Miacomet Rip. These areas can be located at low water by a line of white water and surf curving away from shore.

The possibility of confusing beach shells and fossil material is well illustrated by this situation on Nantucket and points up the desirability of basing distributional records on living material whenever possible.

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LIFE HISTORY AND POPULATION STUDIES OF *ACHATINA FULICA*

By WILLARD KEKAUOHA¹

The purpose of this paper is to present certain findings regarding the Hawaiian form of *Achatina fulica* Bowdich: (1) period of egg production; (2) reproductive potential; (3) frequency of ovulation, period, capacity and viability; (4) viability of aborted eggs; (5) growth, aestivation and self-fertilization; and (6) census of two local populations.

Determining the Period of Egg Production.

Egg production was determined by fracturing the snails with a hammer following the "smash" technique suggested by Dr. Yoshio Kondo, Malacologist, Bernice P. Bishop Museum. A total of 5945 specimens between 50 and 125 mm. in length were examined to determine the number of egg-bearing snails from the three neighboring locations: Kahuku, Laie and Hauula on Oahu for the 1964 and 1965 seasons (Table I). No attempt was made to count the number of eggs in each individual snail during the June 1964 to July 1965 test. However, the number of eggs ranged from 50 to over 100 per specimen. In the 1965 season the eggs in snails killed ranged from 79 to 269 per specimen.

Data collected over a period of 18 months (Table I) show that the 1964 egg-laying season for *Achatina* was from June to December while the egg-laying season for 1965 was from May to November.

The data on egg production (Graph A and Table I) disclose the following significant points: (a) egg-laying commenced on June 30, 1964 (2% of snails killed had eggs); there was a small increase on August 24 (6%) followed by a drop on October 5 (5%); (b) there was a steep rise to November 14 (14.1%) and

¹ Science Teacher, Kahuku High School. This research was supported by a grant (G.E.-7606) from the National Science Foundation as part of the Research Participation for High School Teachers Program conducted by the University of Hawaii.

TABLE ISUMMARY OF SMASH TECHNIQUE

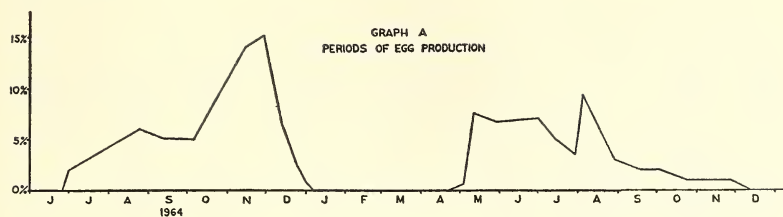
Date	No. of snails killed	No. of snails with eggs	Per Cent snails with eggs
<u>1964</u>			
Jun 23	229	0	0
Jun 25	337	0	0
Jun 30	241	5	2
Jul 1	200*	7	3.5
Jul 2	250*	3	1.2
Aug 24	133	8	6.0
Sep 10	155	8	5.1
Oct 5	140	7	5.0
Nov 14	106	15	14.1
Nov 28	112	17	15.2
Dec 12	105	7	6.6
Dec 23	121	3	2.4
Dec 30	112	1	0.8

<u>1965</u>			
Jan 6	209**	0	0
Jan 14	238**	0	0
Jan 30	242**	0	0
Feb 20	230**	0	0
Mar 26	214**	0	0
Apr 21	270**	0	0
May 3	329**	2	0.6
May 11	119	9	7.6
May 29	108	7	6.7
Jun 30	153	11	7.1
Jul 13	137	7	5.1
Jul 29	141	5	3.5
Aug 4	128	12	9.3
Aug 28	131	4	3.0
Sep 18	102	2	2.0
Oct 2	102	2	2.0
Oct 23	102	1	1.0
Nov 13	102	1	1.0
Nov 27	102	1	1.0
Dec 11	230**	0	0
Dec 18	215**	0	0

* Data taken to verify start of egg-laying season June 30, 1964; not included on Graph A.

**Samples increased January 6 to May 3, 1965 to make sure of the ending of one egg-laying season and the beginning of the next.

November 28 (15.2%); (c) and a sudden drop thereafter on December 28 (6.6%), arriving at point zero on January 6, 1965. (General picture is a gradual increase from June to October, a peak in November, and a quick drop in egg production in De-



cember. There was no egg production from January 1965 to April 1965.

The 1965 egg-laying season began on May 3 (0.6%); it increased on May 11 (to 7.6%), dropped on July 29 (3.5%) and suddenly increased on August 4 (9.3%), followed by a drop on August 28 (3%) and September (2%); it slowly decreased during October (1%) and November (1%) to a point of no egg production on December 11. (General picture is a sudden increase from April to May with peak production in August, followed by a sudden drop in September and a gradual decrease in December.) The 1965 season seems to follow the same pattern as 1964.

Reproductive potential. The reproductive potential of *Achatina fulica* based on the hundreds of eggs per clutch has been thought to be enormous. This may be so, but the actual producers per population per season appear to be between 15 and 35% only: (a) a coarse fecundity test conducted by the "smash" technique tends to show that at peak of season, only 14 to 15% of the population is pregnant with eggs; (b) in an undirected experiment in which the goal was merely to obtain eggs for study from 54 wild snails detected in copulation, these 54 were kept separated from each other in captivity for 38 days between June 16 and July 23, 1964. Of the 54 only 5 laid eggs; 5 were pregnant, detected by the "smash" technique; 3 died within those 38 days; 41 had no eggs at any stage of development. Percentage of pregnancy in this instance is between 19 and 20%, which is close enough to the above quoted 14-15% to be significant; (c) in a second undirected experiment, 20 infant snails were kept in 2 batches of 10 each for scattergram plotting of growth rates between July 12, 1964 and January 28, 1965, a period of 6 months 16 days. One laid 271 eggs; 6 were pregnant when killed and 13 had no eggs. The percentage of pregnancy is 35% for this batch.

Frequency of ovulation, period, capacity and viability. Material

TABLE II

TABLE OF MULTIPLE OVULATION

Spm. No.	Size (mm)	Date	Days between clutches	Hatching time (days)	Number of eggs laid	Number of eggs hatched	Per Cent viable per clutch	Per Cent viable per snail
3	66.7	5 Jul 64	0(20)*	6	65	63	96.9	
	70.4	5 Sep 64	62	7	131	128	97.7	
	72.3	9 Oct 64	34	7	137	124	90.5	
	75.7	2 Nov 64	24	8	141	136	96.4	
	78.4	27 Nov 64	25	9	186	171	91.9	
	78.5	11 Jan 64	45	0	17	0	0.0	
			190		677	622		91.2
4	68.5	7 Jul 64	0(22)*	5	85	85	100.0	
	76.7	6 Oct 64	91	8	123	108	87.8	
	81.3	15 Nov 64	40	7	206	188	91.4	
	81.3	11 Dec 64	26	9	197	183	92.8	
	83.5	9 Jan 65	25	8	165	152	92.1	
			186		776	716		92.2
AQ	103.9	10 Jul 64	0(25)*	5	400	377	94.2	
	105.1	27 Aug 64	48	8	321	284	88.4	
	106.8	10 Nov 64	75	9	368	364	93.8	
	106.8	5 Dec 64	25	7	196	181	92.3	
	106.8	26 Dec 64	21	8	327	302	92.3	
	106.8	22 Jan 65	27	7	185	177	95.6	
			196		1817	1685		92.7
BB	108.2	24 Jul 64	0(39)*	10	207	183	88.4	
	108.4	9 Sep 64	47	8	316	301	95.2	
	109.2	8 Oct 64	29	8	323	320	99.0	
	111.4	3 Nov 64	26	7	442	431	97.5	
	111.5	30 Nov 64	27	7	198	172	86.8	
	111.5	12 Jan 65	43	8	138	128	92.7	
TOTAL					1624	1535		94.5
AVERAGE			34	7	4894	4558		93.1

* Refers to days between isolation and the ovulation of the first clutch.

** Grayish eggs, infertile; apparently aborted before maturity; not considered a normal clutch but included necessarily in the data.

for this study was obtained by selecting copulating pairs of *Achatina* and keeping each snail in isolation (Table II).

On July 5, 1964, the 20th day after isolation, snail #3 (smallest snail, 66.7 mm.) laid 63 eggs; two days later, it laid two more eggs, making a total of 65 eggs. Snail #3 laid six separate clutches of eggs, with egg clutches ranging from 17 to 186 eggs, making a total of 677 eggs laid over a period of 190 days. A total of 622 eggs hatched for a viability of 91.2%. (Last clutch of 17 eggs not considered normal because of low count and infertility. However, such clutches may be a normal occurrence in this species, according to Mead and Kondo through personal communication).

On July 7, 1964, 22 days after isolation, snail #4 laid its first clutch of 85 eggs. Snail #4 laid five separate clutches ranging from 85 eggs to 205 eggs over a period of 186 days. A total of 776 eggs were laid with 716 eggs hatching for a viability of 92.2%.

On July 10, 1964, the 25th day after isolation, snail AQ laid its first clutch of 400 eggs over a period of 2 days. Snail AQ laid six

separate clutches ranging from 185 to 400 eggs per clutch. A total of 1817 eggs were laid over a period of 196 days, with 1685 eggs hatching for a viability of 92.8%.

On July 24, 1964, the 39th day after isolation, snail BB (the largest snail of this study, 108.2 mm.) began laying a clutch of 207 eggs and continued to lay 6 separate clutches of eggs for a total of 1624 eggs during a period of 172 days. Egg clutches ranged from 138 to 442 eggs, with a total of 1535 eggs hatching for a viability of 94.5%.

To summarize, data collected and tabulated (Table II) show that the snails laid five (snail #4) to 6 clutches of eggs (#3, AQ, BB) during their 1964 egg-laying season (July 5, 1964 to January 22, 1965). The average interval between ovulation is 34 days, with intervals ranging from 20 days (snail #3) to 91 days (snail #4). Egg clutches varied from 17 (snail #3) to 442 (snail BB) with an average of 213 eggs per clutch. The interval between the first and last clutch varied from 172 days (snail BB) to 196 days (snail AQ) with an average of 186 days. Hatching time varied from 5 to 10 days with an average hatching time of 7 days. The viability of egg clutches varied from 0% (snail #3, clutch #6 only) to 100% (snail #4). A total of 4894 eggs were laid with 4558 eggs hatching for an average viability of 93.1%.

While this paper was in preparation, snail #4 laid a clutch of two dark yellow eggs on July 29, 1965, 201 days after the last clutch was laid on January 9, 1965, or 410 days after isolation. This clutch represents the beginning of the second (1965) egg-laying season and is not included in the present study (Table II). Snail #4 also laid 32 eggs on September 10, 1965, 43 days after the two infertile eggs were laid with a viability of 27 eggs. On October 5, 1965 (487 days after isolation) 31 more eggs were laid with 24 eggs hatching. Snails #3, AQ, and BB have not produced any eggs in the 1965 season.

SUMMARY OF OVULATION STUDIES

Comparative findings. Number per brood, average per brood, and size of eggs are close to those quoted by Ghose, Lange, Mead and Mohr (Kondo, 1964).

Frequency per season is 5 to 6 clutches per season, differing from Ghose's one brood per year.

No. of eggs per clutch	17-442
Average number of eggs per clutch	213
Size of eggs	5 x 4 mm.
Frequency of ovulation per season	5-6
Interval between first and last clutch	186 days
Average interval between clutches	34 days
Total eggs laid per season	677-1817
Average fertility of eggs	93.1%
Incubation period	1-17 days
1964 egg-laying season	July to January
Growth rate	Same as Kondo's (1964)
Longevity	Observations continuing
Self-fertility	Observations continuing
Aestivation	None to date (18 months)

The interval between the first and last clutch varied slightly from 172 to 196 days, with an average of 186 days.

Total eggs per season was between 677 and 1817 for the isolated individuals.

Fertility averaged 93.1%; greater than Mohr's 80%.

Incubation period of 1-17 days compares well with those of the other observers.

The 1964 and 1965 egg-laying seasons seem to vary slightly. The 1964 season for the isolated individuals (#3, 4, AQ, BB) began in July and ended in January, 1965. The 1965 season began with #4 laying 2 eggs on July 29, 32 eggs on September 18 and 31 eggs on October 5. This appears to be the extent of the 1965 season. It should have paralleled the 1965 season as determined by the "smash" technique (began in May) but so far it has not commenced except for the 3 separate clutches of #4. Dr. Kondo tells me that the supply of sperm in #3, AQ and BB of the July 15, 1964 copulation seems depleted and these 3 may not lay any more eggs while isolated. Snail #4 seems to have retained a very small supply of the 1964 sperm which apparently has been carried over to 1965. Observations are being continued on all 4 specimens.

Self-fertilization appears negative. Certain evidences seem to indicate that copulation is necessary to produce fertile eggs: (1) 10 specimens raised together for scattergram, 35% of which became pregnant; (2) 6 isolated individuals raised from eggs to maturity, still virgins; and (3) two non-virgins (mixed-up accidentally) now producing fertile eggs.

TABLE III
ABORTED EGGS

Specimen No.	1	2	3	4	5	6	7
No. of eggs in vial	20	20	15	6	10	12	10
Color of eggs	MY	LY	G	G	G	LY	MY
Air (Open)	0	0	0	0	0	0	0
Moisture	0	0	0	0	0	0	0
Moist Cotton	0	70%	0	0	0	0	0
Moist Soil	55%	65%	0	0	0	58%	60%

TABLE IV
ABORTED EGGS

Specimen No.	A	A'	B	C
No. of eggs in vial	10	10	10	10
Color of eggs	DY	MY	MY	LV
Air (Open)	0	0	0	0
Airtight	0	0	0	0
Moisture	0	0	0	0
Moist Cotton	0	0	0	0
Moist Soil	70%	50%	50%	60%

Legend: LY Light Yellow
MY Medium Yellow
DY Dark Yellow
G Grayish

Contrary to Kondo's findings, none of the 4 specimens (#3, 4, AQ, BB) or the 8 snails raised in isolation from infancy (snails A to H) have aestivated during the 18 months of captivity.

Viability of aborted eggs. During the test for fecundity by the

"smash" technique, seven egg samples from seven fractured specimens (Table III) were set up to test for viability under four separate conditions: (a) open vial, no soil, no moisture; (b) capped vial, no soil, 2 drops of water; (c) capped vial, no soil, with moist cotton underlying the eggs; and (d) capped vial, moist soil underlying the eggs but not covering them. Unbroken eggs were dissected from the uterus and placed in a petri dish, then transferred to the four separate vials without regard as to where the eggs were found in the uterus of the snail.

This test showed that yellow eggs hatched but the grayish eggs did not, indicating that the yellow eggs were mature while the grayish eggs were immature. (The 70% viability for eggs in moist cotton was possibly due to the fertile eggs being placed in the vials close to hatching time.)

A second test (Table IV) was designed to include only yellow eggs (from three individuals, A, B, C) because the yellow eggs showed 55 to 70% viability (Table III). One sample (A) was subdivided into two groups, A and A'. Group A included the dark yellow eggs from the lower uterus while Group A' were a lighter yellow from the middle or upper uterus of the same individual. The same conditions were used for this test with the addition of an airtight vial, no soil or moisture.

Results show that eggs with any shade of yellow were 50 to 70% viable on moist soil only. In comparing the viability of eggs aborted from a single snail, the eggs with the dark yellow color had a higher viability than the eggs that were light or medium yellow (Table IV).

[To be continued.]

WHAT IS *ARCA CAELATA* REEVE?

BY MORRIS K. JACOBSON AND GORDON USTICKE

Reeve described and figured *Arca caelata* (1844, pl. 16, fig. 110) from an unknown habitat. Subsequently von Martens (1890, p. 320) doubtfully listed this taxon from Mauritius on the basis of material collected there by Möbius. In the same work on the same page he also cited *Arca revelata* Deshayes 1863 from Bourbon and Mauritius. In 1907 Lamy (p. 92) placed *revelata* in the synonymy of *caelata* and accordingly gave Mauritius, Bourbon, and Réunion (the last being the type locality of Deshayes's species) as the "true"



Top figure: *Barbatia caelata* (Reeve), St. Croix, Virgin Islands, [= *B. candida* (Helbling)]. Lower figure: *B. revelata* (Deshayes), Mauritius, [= *B. decussata* (Sowerby)]. Both about 2x.

locality of *caelata*. In this he was followed later by Dautzenberg (1929, p. 368; 1932, p. 96) and Fischer-Piette (1958, p. 120) who reported *caelata* Reeve from Madagascar.

We became interested in this species when the junior author collected 5 valves of an unusual arcid among material pumped up by a commercial dredge from about 6 fathoms of water. This material forms an artificial island lying about 1 mile offshore from Krause's Lagoon on the south shore of St. Croix, Virgin Islands.

Later we found 2 valves of a very similar arcid in the collection of the American Museum of Natural History (no. 89531) from Grand Cayman Island, collector W. A. Swanker. A specimen was collected in Aruba, Netherlands Antilles, by Mrs. Elizabeth Johnson in 1965.

The junior author was able to visit the British Museum (Natural History) where he found, upon comparison, that the shells from St. Croix matched very closely the type specimen of *Arca caelata* Reeve. Hence we concluded that Reeve's shell lives in the West Indies and that the name should not be used for the shell from the Indian Ocean.

Subsequent comparisons of the presumed *A. caelata* with the large collections in the Academy of Natural Sciences of Philadelphia, the Museum of Comparative Zoology, as well as the American Museum, compelled us to accept the point of view that Reeve's species is in all likelihood a striking variation of the common *Barbatia candida* (Helbling). The Reeve name was given to a clean, uncluttered specimen, which, because of differing ecological conditions, was able to develop strongly frilled, radiating ribs.

The collection in the American Museum also contains a complete, well-matured specimen of *Barbatia revelata* (Deshayes) from Mauritius (no. 28647) that was originally in the Steward Collection. This specimen could easily be considered a clean, well-sculptured example of the widely distributed *B. decussata* (Sowerby). It bears a superficial resemblance to *A. caelata* Reeve but it can easily be separated as follows: *caelata* (Reeve) (= *candida* Helbling) has a heavier, more inflated shell with fewer and much stronger radial ribs, strongly decussated by rows of concentric cords, that, toward the ventral area, are raised into scale-like structures where they cross the radial ribs. The six heavy ribs on the posterior slope are higher and far more strongly decussated than the corresponding ribs in *revelata* Deshayes (= *decussata* Sowerby). The differences noted here are also apparent in the figures of Reeve and Deshayes, copied by Kobelt (1891, pl. 14, fig. 3-5, pl. 47, fig. 14). The specimen of *B. caelata* figured herein is probably worn and hence does not show the raised decussations quite as clearly as in Reeve's figure.

The authors wish to express their gratitude to the Trustees of the British Museum who generously permitted Mr. Peter Dance to compare the present specimens with the type of *Arca caelata* Reeve,

and to Mr. William Old, Jr., who provided pertinent material from the collection of the American Museum of Natural History. Dr. R. Tucker Abbott and Dr. William J. Clench gave valuable advice and readily made accessible the collections in their respective institutions for comparative purposes. Dr. William K. Emerson kindly read the manuscript and provided many helpful suggestions.

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MYA ON THE ALASKA PENINSULA

BY JAMES X. CORGAN

Sinclair Oil & Gas Company, Tulsa, Oklahoma

This is an adjunct to a monograph of *Mya* by MacNeil (1965). Geographic ranges of *Mya elegans* (Eichwald) and *M. japonica* Jay are extended. A possible gap in the distribution of *M. truncata* Linné is suggested.

Six species of *Mya* are currently recognized in the living fauna and all occur in Alaska. One, *M. arenaria* Linné, seems to owe its presence in southeastern Alaska to human introduction. The five remaining species have, or appear to have, naturally restricted distributions within Alaska.

In other parts of the world, contrasts between ancient and modern distributions of species of *Mya* have proven useful in establishing local glacial and human chronologies. This is not true in Alaska and the genus is a yet unexploited Alaskan economic resource. Thus, a recording of new Alaskan *Mya* localities seemed worthwhile.

Distribution. Most species of *Mya* range widely outside of Alaska. Only Alaskan distribution is here considered. For each species,

MacNeil (1965) provides a specific characterization, a detailed synonymy, and a list of occurrences. In much abbreviated form, MacNeil's data are here given as the established range and the synonymy.

Data. New occurrences, here reported, are based on a suite of 44 beach shell samples obtained from the Alaskan Peninsula and adjacent regions by Allan P. Bennison, of the Sinclair Oil & Gas Company, and me during the summer of 1965. Collections cover both coasts from Pavlof Bay to Wide Bay. All areas mentioned in discussions of the distribution of species are located in Figure 1.

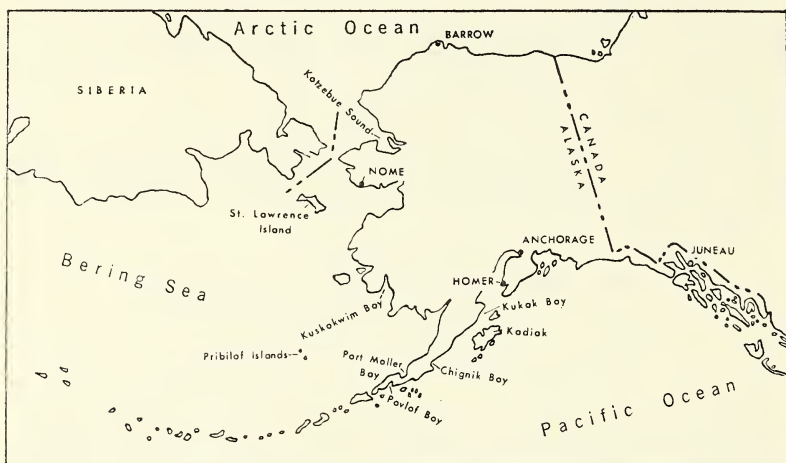


Figure 1. Index map. Named areas are cited in distribution records.

Literature on *Mya* in Alaska has been adequately summarized by MacNeil (1965). Since specific synonymies are intricate and modern concepts of species differ significantly from those long held, MacNeil excluded, or questioned, many published, but unillustrated, occurrences. In part, this mass of dubious literature forms a secondary control and permits a tenuous filling in of patterns of occurrence.

Mya (?*Arenomya*) *elegans* (Eichwald)

Synonymy: *M. crassa* Grewingk; *M. intermedia* Dall; *M. profundior* Grand and Gale; and, in part, *M. arenaria* and *M. japonica* of authors.

Distribution: Pribilof Islands; Kuskokwim Bay; Bristol Bay; Chignik Bay; Kukak Bay.

New Occurrences: Living: Port Moller Bay; Pavlof Bay; subfossil: in a Port Moller Bay midden.

Remarks: The name *M. elegans* was first applied in Alaska by MacNeil (1965). Interpretation of earlier reports is difficult though MacNeil noted questioned records on the southern Alaska Peninsula and in the Aleutians.

New occurrences, here recorded, significantly extend the definitely known range in Alaska. They also lend support to MacNeil's interpretation of the unillustrated record.

It should be noted that new records, here established, are also unillustrated; however, MacNeil's well illustrated monograph greatly increases the possible reliability of identifications.

Mya (Arenomya) japonica Jay

Synonymy: *M. oonogai* Makiyama and, in part, *M. arenaria* of authors.

Distribution: Recent: Nome and Kotzebue Sound; Pleistocene: Nome to Willapa Bay, Washington.

New Occurrences: Port Moller Bay and 8 miles north of Port Moller along the Bering Coast. All collections contain shells with fragments of the ligament attached but the species was not observed alive. Subfossil *M. japonica* occur in a midden on Port Moller Bay.

Remarks: Lack of *M. japonica* in collections from other areas, its prominence in modern and subfossil faunas of the Port Moller area, and the marked difference between known Pleistocene and Recent distributions suggest that the Port Moller population may be an isolated relict of the more widely distributed Pleistocene population rather than part of the northern Alaska population.

Mya (Mya) priapus Tilesius

Synonymy: In part, *M. arenaria*; *M. truncata*; and *M. japonica*, of authors.

Distribution: Northern Bering Sea to the Aleutians to Homer Spit.

New Occurrences: The most common *Mya* of the region, present in all major bays on each coast.

Remarks: The name *M. priapus* was not in common use prior to MacNeil (1965).

Other *Mya*

Mya (Mya) pseudoarenaria Schlessch is recorded by MacNeil

(1965) from Point Barrow and the Arctic Coast. It does not occur in peninsular collections. *Mya* (*Arenomya*) *arenaria* Linné does not range as far north as the Alaska Peninsula.

The only other Recent species of *Mya* is *Mya* (*Mya*) *truncata* Linné which MacNeil (1965) illustrates from Kodiak Island and from St. Lawrence Island. The species thus occurs both north and south of the Alaska Peninsula; however, it is absent from the 44 collections at hand.

Soot-Ryan (MacNeil, 1965, p. 40) states that *M. truncata*, which is essentially circumboreal, is absent from the East Siberian Sea. Possibly it is also absent from the Alaska Peninsula.

In the Anchorage region, at the beginning of the Alaska Peninsula, *M. truncata* is locally the dominant mollusk on modern beaches. Occurrences seem limited to areas where the Bootlegger Cove Clay, of Pleistocene age, forms the shoreline. In these areas, *M. truncata* is also the most common species in the fossiliferous Pleistocene clay. All Anchorage specimens which I have seen appear to be reworked fossils and the species may not occur in the modern fauna of the Anchorage area. It should be noted that MacNeil (*In* Schmidt, 1963; *In* Miller and Dobrovolny, 1959) had previously listed *M. truncata* from the Bootlegger Cove Clay.

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CORBICULA MANILENSIS IN THE MESILLA VALLEY OF TEXAS AND NEW MEXICO

BY ARTIE L. METCALF
Texas Western College

This report concerns the clam known colloquially as the "Asiatic clam" and referred by Sinclair and Isom (1963: 33) to *Corbicula* (*Corbiculina*) *manilensis* (Philippi). The clam has become established in "West Drain" of Mesilla Valley, which is a broadened part of the Rio Grande Valley extending from El Paso, El Paso County,

Texas to Radium Springs, Dona Ana County, New Mexico. The generally north-south trending West Drain crosses the New Mexico-Texas border in several places; clams were observed in both states. The term "West Drain" is a locally-used name referring to a drainage ditch—one of a system of such ditches that form the chief permanent-water habitat of the Mesilla Valley. Drains are distinct from irrigation ditches, which carry water to fields of the valley and which are dry during the winter months. The drains were constructed mainly between 1917 and 1930 to alleviate the adverse effects to agriculture of a rising water table (Clark and Mauger, 1932: 14-16; Conover, 1954: 53-58). The channels of the drains are generally 6-10 feet deep and 8-20 feet wide at the bottom. The amount of discharge seems variable. Thus, during the years 1962-65 there was permanently flowing water in the lower parts of the major drains (including West Drain), but the upper reaches were periodically dry. Water in the drains is usually clear. A narrow fringe of phreatophytic shrubs and small trees borders the drains in most places; cottonwoods occur rarely. Along the bottoms of the drains grasses, rushes, cattails and other plants are common. Watercress, duckweeds and algae are the chief aquatic plants. The bottom sediments are mixed silt and sand, with gravels up to six inches in diameter occurring in some places.

Regarding characters of the shell, specimens from West Drain are subtrigonal to ovate, possess low umbones, a fine sculpture and an intensely purple nacreous layer. Of the American specimens illustrated by Sinclair and Isom (1963), the clams from West Drain seem most nearly to resemble figures 31-36, of clams from Phoenix, Arizona.

C. manilensis seems to have become recently established in West Drain, although the species has inhabited the drain long enough for individuals taken in November, 1964 (when the clam was first observed) to have reached 25 mm. in length and for specimens taken in November, 1965, to have reached 34 mm. in length. Sinclair and Isom (1963: 4) estimated that a specimen of 28 mm. from Tennessee was four years old. The population of Asiatic clams in West Drain is probably not of long standing, as bank sediments contain many shells of other species of aquatic mollusks but none of *C. manilensis*. The drains are periodically cleaned by power-shovel, and the sediments, containing shells taken from the

bottoms of the drains, are heaped alongside the drains; eventually much of this shell-bearing sediment falls back down along the walls of the drains. None of several persons contacted in federal and state agencies connected with irrigation and agriculture was aware of the presence of the clams in the Rio Grande Valley, which also suggests recent establishment. To my knowledge, *C. manilensis* has not previously been reported from Texas or New Mexico, the nearest record being that of Dundee and Dundee (1958) from Phoenix, Arizona.

Sinclair and Isom (1963: 12) found that *C. manilensis* occupied a wide variety of habitats in the Ohio River System of Tennessee and that its dispersal within a stream system was rapid. It is, then, of interest that *C. manilensis* has been found in only one drain, of many inspected, in the Rio Grande Valley between El Paso, Texas, and Hatch, New Mexico. Possibly the Rio Grande acts as a barrier to dispersal between the drains tributary to it, either because it is an inhospitable habitat for larvae or because it may be completely dry in some sections when crops are not being irrigated. These recurrent periods of desiccation of parts of the river (the longest usually lasting from October to March) preclude establishment of permanent populations in the main channel of the Rio Grande in this area, except, possibly, immediately below the mouths of major drains. Alternately, the absence of *C. manilensis* in other drains may be attributable to some difference in environmental conditions. This seems especially plausible, because *C. manilensis* does not seem to have established populations in the tributaries of West Drain, — Nemexas Drain and Montoya Drain. Between October, 1964, and January, 1965, chemical analyses were made of water taken from West Drain and from Nemexas Drain at places a short distance above their confluence. The chief differences observed were in degree of hardness, with West Drain yielding higher values. Samples from West Drain gave readings for total hardness ranging from 365 to 410 ppm and for calcium hardness of 280-320 ppm. Water from Nemexas Drain yielded values for total hardness of 250-290 ppm and for calcium hardness of 180-215 ppm. Leggat, Lowry, and Hood (1962: Fig. 20) obtained values similar to those noted above for water analyzed from West Drain (they did not report on Nemexas Drain). These writers noted (p. 48) "In general, the drain water increases in dissolved-solids

content from the upper to the lower end of the West Drain . . . The increase is due principally to the accretion of ground water in which mineralization increases toward the lower end of the valley, and also to the concentration of the dissolved salts in the drain water by evapotranspiration." The snail *Physa anatina* Lea was more abundant in Nemexas Drain than in West Drain and there seemed to be some differences between the aquatic floras of the two drains. Possibly these floral and faunal differences are related to volume or velocity of flow, or to chemical composition of the waters.

The negative economic implications of *G. manilensis* have been discussed at length by Sinclair and Isom (1963). In the Ohio River System it has obstructed pipes carrying water from rivers (the larvae entering the pipes, attaching to the inner surfaces of the pipes and then growing to adulthood), and has become a problem in the gravel industry (burrowing upward in newly-poured concrete made with *Corbicula*-containing gravels). Ingram, Keup and Henderson (1964: 121-122) reported that the high degree of infestation of Asiatic clams in concrete-lined irrigation canals near Parker, Arizona, necessitated their removal. These authors further noted (p. 124) "... this clam creates nuisance conditions in canals, ditches, pumps, and cooling systems." Sediments from the drains in Mesilla Valley are not used in concrete making and, to my knowledge, water is not piped from the drains for industrial or other purposes. However, a concrete flume carries the combined waters of West and Nemexas drains under and across the Rio Grande *ca.* one-half mile below the confluence of the drains.

Positive economic aspects of the genus *Corbicula* have been discussed by Villadolid and Del Rosario (1930: 355, 370) and Sinclair and Isom (1963: 27-28), and include use as human food, as food for domestic animals, and as fish bait. A party of young fishermen was once observed industriously collecting *G. manilensis* for fish bait from West Drain.

I am grateful to Dr. Ralph Sinclair, Tennessee Department of Public Health, for information and advice, and to the following persons, who kindly offered suggestions concerning the manuscript: Mrs. Eleanor Duke and Dr. Robert G. Webb, Texas Western College, and Dr. L. O. Sorensen, Pan American College, Edinburg, Texas.

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ANONYMOUS CATALOG OF OHIO RIVER UNIONES

BY NORA F. McMILLAN AND MARJORIE FOGAN

An apparently unknown conchological publication listing the Unionacea of the Ohio River was recently acquired by one of us (M. F.) and has prompted the present note.

The work is a 20 page pamphlet in small 8vo. and the title-page runs: "Catalogue / of the / unios, / alasmodontas, and anodontas / of the / Ohio River and its northern tributaries, / Adopted by the Western Academy of Natural Sciences, / of Cincinnati, January, 1849, / Cincinnati; / printed by J.A. & U.P. James." Alternate pages are blank and unnumbered; on the numbered pages 67 species are listed and in most cases some synonyms are given. None of the species appears to be new.

There is no indication of the author's identity but an unsigned slip pasted on the back of the title-page states "Mr. Wheatley seems to have given up the shells I could not procure a copy of his catalogue here but beg you will accept of my only copy." The hand-writing is old and unfamiliar; it is not that of Lea. The title-page bears the autograph "Dr. Sorrain" in a quite different ink and hand-writing.

Charles Moore Wheatley was born in 1822 and died in 1882. An engineer by profession, he was not a prolific writer and Johnson (1959) only mentions two conchological papers by Wheatley, a privately-printed "Catalogue of the shells of the United States, with their localities" (1842; a second edition was issued in 1845) and "Revision of M. Petit's catalogue of the genus *Monocondylaea* D'Orb." (Am. Journ. Conch. I: 65-67. 1865). He also published a few papers on geological subjects. Lea named a number of species after "my friend C. M. Wheatley who has done so much for this branch of natural history," and in the case of *Diplodon wheatleyanus* (Lea) stated "was sent to me some time since by Mr. C. M. Wheatley who procured it from the Rio Negro, at the distance of 1200 miles from the mouth of the Amazon. . . .". Wheatley is described by Dall (1888, p. 118) as "of Phoenixville, Pennsylvania"; an account of the present location of his collections is given by Johnson (1959).

Perhaps it is not quite correct to refer to the subject of this note as being an unknown work for in Lea's 1870 *Synopsis* it is referred to on p. 171, without, however, ascription to any author.

Photostats of the Catalogue are now in the possession of Mr. A. Blok (Rottingdean, England), Dr. Haas (Chicago), and Mr. F. R. Woodward (Paisley, Scotland).

Neither Dr. Clench nor Dr. Haas knew of the existence of this Wheatley catalogue and we are grateful to them for their interest in the matter and to Dr. Clench for a copy of Johnson's paper on the Wheatley collections.

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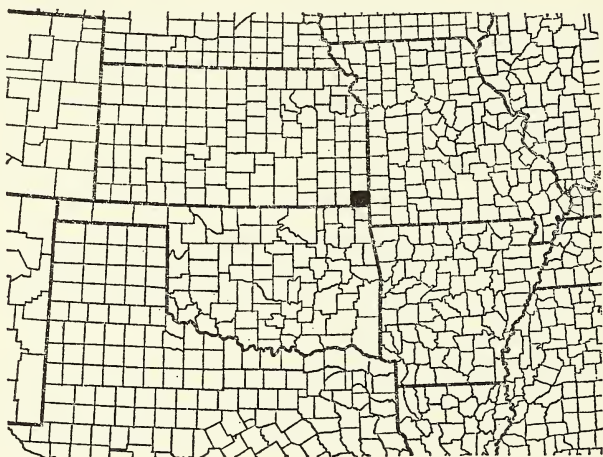
ALASMIDONTA MARGINATA AND PTYCHOBANCHUS FASCIOLARIS IN KANSAS

BY BRANLEY A. BRANSON

Dept. Biol., Eastern Kentucky State College, Richmond, Kentucky

In their survey of the unionid mussels of Kansas, Murray and Leonard (1962) indicated that clear-water streams were absent in Kansas, the combined results of unwise farming practices and strip-

mining by-products. In general, this is unfortunately true. However, in the extreme southeastern corner of Cherokee County (Map 1) the Carolinian Biotic Province barely dips into the state, and in that area Shoal Creek flows for 5 miles to its confluence with Spring River. Shoal Creek is quite clear, being fed by numerous springs, and as such is one of the most important ecological elements in the state. For example, 62 per cent of the fish species known from Kansas also occur in Shoal Creek and/or adjacent Spring River, and 14 species, or 11 per cent of the total fauna, are known only from that stream (unpublished data). There are also several mollusks known only from that area.



Map 1. Position of the Spring River Drainage in Kansas, the only Ozarkian system in the state.

During the preceding 4 years, the author has been conducting an extensive biological survey of the Spring River Drainage in Missouri, Oklahoma and Kansas. As a matter of course, a collecting station was selected on Spring River proper at the point where the river crosses Kansas State Highway 96, R 25 N, T 33 S, Cherokee County. This site is characterized by a series of braided channels, gravel-bottomed riffles of 2½ feet to 3 feet in depth, and great quantities of *Dianthera americana*. It lies near the mouth of Cow Creek, a small muddy and badly polluted stream of approximately 30 miles in length, and about two miles above the mouth of Shoal Creek. The water is relatively clear. On 14 March 1964 a collecting

party visited this station and secured extensive samples of fishes and moderate ones of pelecypod mollusks. In the mussel samples were discovered 3 specimens of *Alasmidonta marginata* Say and one of *Ptychobranchus fasciolaris* (Rafinesque).

Alasmidonta marginata has not heretofore been known from Kansas, although we have numerous records for the species in Oklahoma and Missouri. The largest specimen measured 97.0 mm. in length, and 47.0 mm. in greatest depth.

Since no specimens of *P. fasciolaris* have been collected in Kansas since 1890 (Murray and Leonard, 1962), and since there seems to have been considerable confusion as regards which species of *Ptychobranchus* was actually present in the original collections (Simpson, 1914; Scammon, 1906), our specimen is of considerable interest. The shell is 98.2 mm. in length and 55.8 mm. in greatest depth. It is strongly compressed and quite heavy, the nacre being pearly white. The umbones are very low and compressed, slightly eroded. The epidermis is greenish-horn posteriorly, grading to darker horn anteriorly. There are approximately 16 green, wavy, thin lines radiating from the umbonal region on the posterior slope. Internally, the pseudocardinals are rather small and moderately serrate. The laterals are characteristically short, decurved and heavy. The long, broad interdentum is smooth, and the beaks are nearly flush with its sides. The muscle scars are characteristic for the species: retractor small, deeply placed beneath the lateral tooth; adductor deep, directed posteriad. Anterior scars also deep, in front of pseudocardinals. The pallial line is distinct and impressed for its entire length.

The two species discussed briefly above were found associated with the following mussels. The number in parentheses indicates the number of specimens secured in this random sample. *Lasmigona costata* Rafinesque (2), *Plethobasis cypha* (Rafinesque) (1), *Strophitus rugosus* (Swainson) (17), *Tritogonia verrucosa* (Rafinesque) (12), *Actinonais carinata* (Barnes) (15), *Anodonta grandis* Say (1), *Quadrula quadrula* Rafinesque (11), *Quadrula pustulosa* (Lea) (17 pustulate, 10 non-pustulate), *Quadrula nodulata* Rafinesque (1), *Lampsilis anodontoides* (Lea) (1), *Lampsilis luteolus* Simpson (= *L. siliquoidea* Barnes) (9), *Lampsilis ovata* (Say) (28), *Amblema costata* Rafinesque (6), *Elliptio dilatatus* (Rafinesque) (27), *Ligumia recta* (Lamarck) (3), *Ligumia subrostrata*

(Say) (7), *Fusconais flava* (Rafinesque) (12), *Pleurobema cordatum* Rafinesque (5).

This is a fairly respectable fauna, and it doubtless reflects the ameliorating influence of the unpolluted waters of nearby Shoal Creek.

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A NEW POMATIASID FROM CHIAPAS, MEXICO

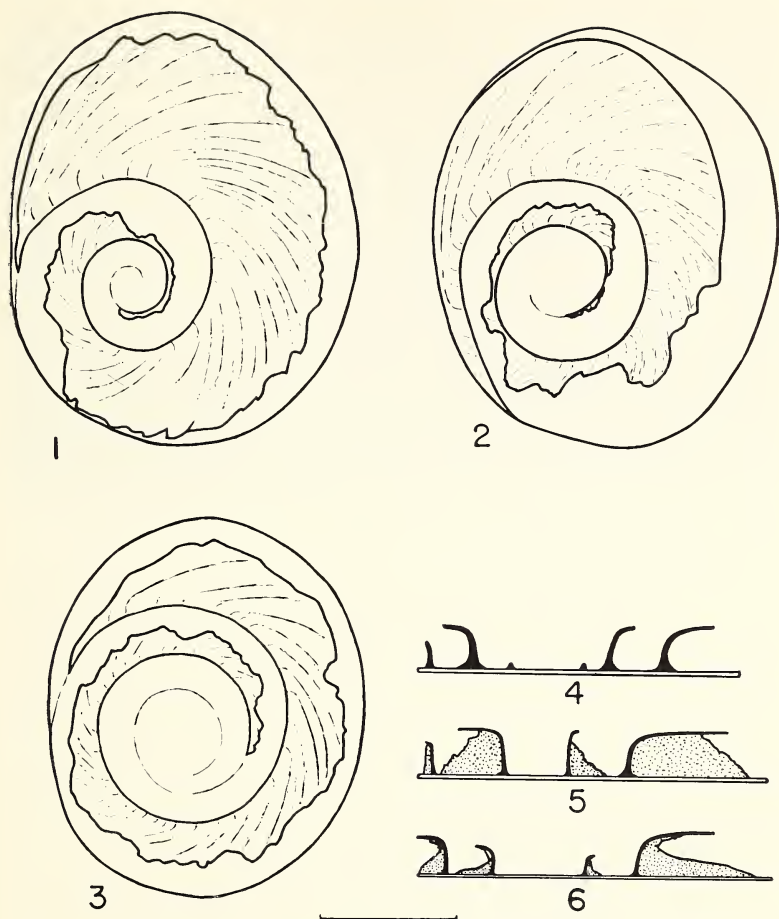
BY FRED G. THOMPSON

Florida State Museum, University of Florida

Recent collections from Mexico have produced an interesting new land snail of the family Pomatiasidae. Characteristics of its operculum and radula place it in the genus *Choanopoma*, subgenus *Choanopomops* as defined by Baker (1928: 47-49). Because of its smooth, costulate sculpture it is named:

CHOANOPOMA TERECASTATUM, new species. Figs. 1, 5, 7

Shell (figs. 7) conical, 0.53-0.60 times as wide as long. Shiny; light orange in color with vague alternating light and dark zones; slightly darker on upper whorls. Peristome and aperture same color as rest of shell. Shell with 4 faint, narrow, broken rose-colored bands which may be indistinct in old specimens; upper 2 bands located near periphery of whorls and visible through length of shell; lower 2 bands evident only on base of last whorl. Decollate, 4.2-4.7 whorls remaining. About 2.0-2.5 juvenile whorls lost in adult shells. Apical plug purplish, sloping, about $\frac{1}{4}$ whorl long. Suture deeply impressed. Whorls strongly inflated; suprapерipheral area moderately curved, sloping, not shouldered; peripheral and subperipheral area more strongly rounded. Umbilicus about $\frac{1}{5}$ - $\frac{1}{6}$ diameter of shell. Aperture adnate to preceding whorl; broadly ovate, 1.07-1.16 times as high as wide; 0.34-0.36 times length of decollate shell. Inner peristome not extended; demarcated only as a strong annulation on lip. Outer peristome strongly expanded;



Opercula of Mexican *Choanopoma*. Fig. 1, *C. terecostatum* Thompson, frontal view. 2, *C. martensianum* (Pilsbry), frontal view. 3, *C. sumichrasti chiapense* Crosse and Fischer, frontal view. 4, *C. sumichrasti chiapense* Crosse and Fischer, transverse section. 5, *C. terecostatum* Thompson, transverse section. 6, *C. martensianum* (Pilsbry), transverse section. Scale equals 1 mm.

about 0.5-0.8 mm. wide or about $1/5$ - $1/7$ width of aperture; widest at upper corner, which is vertical and not deflected. Outer peristome constricted in parietal region and only slightly flexed forward. Sculpture of adult shell consisting of smooth, uniformly spaced axial ribs that are slightly oblique and weakly recurved. Five-six ribs per mm. on body whorl; slightly more crowded on early whorls.

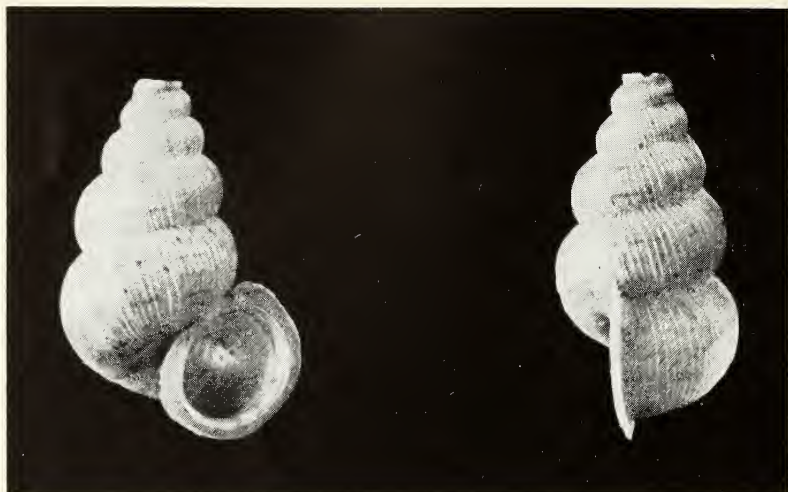


Fig. 7. *Choanopoma terecostatum* Thompson, Type (UMMZ. 216554).

Ribs of uniform intensity from suture to umbilicus, where they become reduced to sharp threads. Spiral sculpture absent. Two embryonic whorls (lost from adult shells) smooth.

Operculum flat, consisting of about 3.5 rapidly expanding whorls. Nucleus acentric. Calcareous lamella broadly reflected over basal chondroid plate and nearly covering latter (fig. 1). Reflected lamella parallel to chondroid plate and supported by numerous narrow calcareous buttresses and ribs that parallel growth striations (fig. 5). Lamellae of adjacent whorls separated.

Measurements of type: length, 12.4 mm.; minor diameter, 7.1 mm.; aperture length, 4.4 mm.; aperture width, 4.1 mm.; lip, 0.8 mm. wide; 4.4 whorls remaining.

Measurements of paratypes: length, 12.0-13.1 mm.; minor diameter, 6.5-7.3 mm.; aperture length, 4.2-4.4 mm.; aperture width, 3.8-4.1 mm.

Type locality: Limestone hillside 15.8 miles northwest of Ocozocoautla, Chiapas; 2700 ft. alt. *TYPE*: UMMZ. 216554; collected July 21, 1965 by Fred G. Thompson. *Paratypes*: UMMZ. 216555 (6), USNM, 669201 (1), ANSP. 305051 (1), MCZ. 260881 (1), Museo Nacional de Mexico (1); same data as the type. UMMZ. 216556 (1); 13.4 mi. n.w. of Ocozocoautla.

C. terecostatum is distinguished from all other mainland species

of the genus *Choanopoma* (as defined by Solem, 1961: 194-195) by its smooth, costulate sculpture, its lack of spiral sculpture, and its operculum, which bears a broadly reflected calcareous lamella reinforced by numerous thin calcareous buttresses and ribs.

Relationships with other mainland forms are indicated by the structure of the operculum. On the basis of opercular similarities *C. terecostatum* is closely related to the group of species that contains *C. martensianum* (Pilsbry) (figs. 2, 6), *C. gaigei* Bequaert and Clench, *C. largillierti* (Pfeiffer) and *C. radiosum* (Morelet), although no particular relationship is indicated with any of these species. It is distinguished from all by its lack of spiral sculpture and by its smooth axial ribs. *C. martensianum* is geographically the closest related form to *C. terecostatum*, being found in adjacent regions of Tabasco. *C. martensianum* differs from *C. terecostatum* in being more slender (0.40-0.50 times as wide as long), in having rugose sculpture due to the occurrence of nodes on the axial ribs where they cross spiral threads, in having the upper corner of the outer peristome recurved posteriorly, and in being light brown in color with four or more broken peripheral bands.

Superficially, *C. terecostatum* resembles *C. sumichrasti* Crosse and Fischer because of similarities of their axial sculpture and their lack of spiral sculpture, but these similarities are secondary, for *C. sumichrasti* has a simple reflected opercular lamella that lacks reinforcing calcareous buttresses or deposits (figs. 3, 4).

The shell of *Choanopoma terecostatum* is nearly identical to that of *Chondropoma rubicundum* (Morelet), but the latter species is immediately recognized by its simple, chitinous operculum.

Specimens Examined. Material examined during this study significantly adds to the distributions of several species reported by Solem (1961: 191-213).

Choanopoma martensianum (Pilsbry)

Tabasco: 2.6 mi. e. Teapa; 1.5 mi. e.n.e. Teapa; 4.0 mi. w. of Teapa; hill 9.2 mi. s. Tacotalpa.

Choanopoma radiosum (Morelet)

Guatemala (Dept. Izabel): Puerto Matias de Galvez; 4 km. n. of Morales.

Choanopoma sumichrasti var. *chiapense* Crosse and Fischer

Chiapas: 8.6 mi. e. Chiapa de Corzo, 3100'; 14.9 mi. e. of Chiapa de Corzo, 4400'; 8.0 mi. n. Tuxtla Gutierrez, 3800'.

Choanopoma sumichrasti var.

Chiapas: 4.5 mi. n. Bochil, 4600'.

Choanopoma sumichrasti var.

Chiapas: 1.4 mi. s. La Trinitaria.

Choanopoma sumichrasti (?) var.

Chiapas: 8.2 mi. s. Solusuchiapa, 1600'.

Choanopoma gaigei Bequaert and Clench

Campeche: Eight localities (to be reported later). *Quintana Roo*: 4.0 mi. e. Xpujil (Campeche); 7.1 mi. n.n.w. Polyuc; 2.3 mi. s.s.e. Polyuc.

Yucatan: 0.8 mi. n.e. Becanchen.

Choanopoma largillierti (Pfeiffer)

Campeche: Seventeen localities (to be reported later). *Quintana Roo*: 4.0 mi. e. Xpujil (Campeche); 7.1 mi. n.n.w. Polyuc; 2.3 mi. s.s.e. Polyuc. *Yucatan*: 7.0 mi. s.s.e. Uman; 19.1 mi. s.s.e. Uman; 0.8 mi. n.e. Bechanchen; 10.0 mi. n.e. Bechanchen; 3.2 mi. s. Progreso; 1.0 mi. s.s.e. Puerto Telchac; Uxmal.

Choanopoma sp.

Ten localities in Campeche, Yucatan and Quintana Roo. (To be reported later.)

Material upon which this study is based was collected with the support of the National Institutes of Health research grant number 5 R01. GM. 12300-02. All material, unless otherwise stated, has been deposited in the Florida State Museum.

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NOTES AND NEWS

DATES OF THE NAUTILUS. — Vol. 79, no. 1, pp. 1-36, iii, pls. 1-3, was mailed July 9, 1965. No. 2, pp. 37-72, iii, pl. 4, Oct. 15, 1965. No. 3, pp. 77-108, iii, Jan. 25, 1966. No. 4, pp. 109-144, iii, and Index, pp. iii-vii, April 25, 1966. — H. B. B.

AMERICAN MALACOLOGICAL UNION. — The 32nd annual meeting will be held Aug. 22-27, 1966, at the University of North Carolina,

Chapel Hill, N. C. Reservations will be made by James E. Wadsworth, Wilson Court, Chapel Hill, N. C. 27514.

CORRECTION. — The submission of a reversed photograph, fig. 1 on p. 130 of the April issue, was an oversight by the author and he wishes to apologize for this misrepresentation. — J. SHERMAN BLEAKNEY.

HAROLD HANNIBAL 1889-1965. — Word has just been received at the California Academy of Sciences of the death of Harold Hannibal on December 17, 1965, after a prolonged illness. Conchologists will remember Mr. Hannibal for his work on fresh-water mollusks of the West Coast, especially for his chapter on them in the 1910 edition of Keep's "West Coast Shells" and his "Synopsis of the Recent and Tertiary Mollusca of the Californian Province" published in 1912 in the Proceedings of the Malacological Society of London. He was a graduate of Stanford University with a major in paleontology and was also the author of several important papers in this field. — ALLYN G. SMITH.

LAND SNAIL RESISTANCE TO COLD. — A paper bag of aestivating snails was placed in my car January 2, 1949, and accidentally left there overnight at below freezing temperatures. It was then placed in a warm room for two weeks. All the snails were alive when placed in the bag. The dead specimens are in parentheses. *Ashmunnella rhyssa edentata* 7 (2); *Allogona profunda* 1 (1); *Bradybaena similis* 0 (3); *Cepaea nemoralis* 0 (5); *Helminthoglypta traski fieldi* 0 (5); *Mesodon kiowaensis* 0 (7); *Monadenia fidelis* 3 (5); *Theba pisana* 1 (1); *Oreohelix strigosa* (from near Salt Lake, Utah) 1 (2). — GLENN R. WEBB.

BIRTH FREQUENCY IN *LACTEOLUNA SELENINA* (Gould) — Three surviving adults of material collected at Coral Gables, Florida, in the spring of 1950 were isolated into tin-can cages A, B, and C. Each can was nearly completely filled with earth and covered with a square of glass. The specimens were caged March 18, 1951. When young were found in the cages, the adults were placed in a new can-cage. This prevented unseen young from accumulating in the cage and confusing the results. Cage A yielded one young March 30; another young April 8. Cage B had 4 young of two sizes March

30; one young April 1; one young April 8. Cage C contained two young March 23; two more young March 30; and one young April 8, 1951. Apparently the species gives birth to one or two young at nearly weekly intervals. Probably the process is seasonal.

A combined courtship and birth occurred on April 15, 1951. On this occasion the 3 adults had been placed in one cage for observations on possible matings. Soon a pair were seen head-on with foreparts detached from the cage cover-glass. They then pressed their foreparts or 'necks' together laterally. One then turned away and pivoted counterclockwise (as viewed through the glass) and rejoined its mate head-on. The pair remained passively head-on for about an hour, became active again, but then separated. Later a pair were seen in courtship. Again the necks are pressed together on the non-genital-pore side. Both pivot, rejoin head-on. Repeat the "necking" act as before. During the act the lips or lower part of pedal disk is projected forward as an angularity. One begins to pivot; the other suddenly gives birth to a young snail. This egresses easily from the atrial pore and is not enclosed in egg or other membranes. The parent crawls forward and meets the partner which fails to respond. The parent continues crawling and encounters the third adult and makes head-on advances. The latter does not respond; the ex-mother commences to gnaw on its aperture edge. It turns and the third snail and it engage in the "necking" act. The sides in contact are the non-genital-pore sides. The third snail climbs onto the ex-mother's shell and the latter crawls off twitching the shell. The snail descends from the shell; the ex-mother crawls on and comes within tentacle sensing distance of the new-born. The parent turns from it, and it turns from the parent. No baby-eating here.

Under the dissecting scope the new-born is seen to have the dorsal surface of the spire marked with fine spiral lines, but hairs or papillae are lacking. The young shell is not subcarinated. The new-born was observed to crawl a few minutes after being born. None of the adults mated. — GLENN R. WEBB.

COPULATIONS BETWEEN *XOLO TREMA* (*WILCOXORBIS*) *FOSTERI* AND *TRIODOPSIS TRIDENTATA FRISONI*. — On May 29, 1952 a *frisoni* and a *fosteri* were found copulating. I tried gently pulling them apart but found they were united by the sex-organs. Reciprocity was not evident.

A second such mating was noted June 5, 1952. The long penis of the *fosteri* extended across the front of the foot and into the orifice of the female-organ of the *frisoni*. As I began to invert the cage cover-glass to examine the details of the union, they disengaged and I saw the penis-tip of the *fosteri* withdrawn across the foot of the other, which had the orifice of the female-organ filled with whitish material, possibly received semen. The *frisoni* had not everted its penis. Two days later this snail was noted with its foreparts in the soil; I then dug up and removed 4 eggs from the spot. The specimens of *X. fosteri* (F. C. Baker) derive from specimens collected about April 5, 1947 from the Mississippi River floodplain near Tiptonville, Tennessee by William Robertson. The *T. t. frisoni* F. C. Baker derive from specimens collected April 20, 1947 by Tom Hanning and Quintin Pickering near Shetlerville, Hardin County, Illinois. — GLENN R. WEBB, Kutztown State College, Kutztown, Pa.

FURTHER NOTE ON DISTRIBUTION OF CYMATIIDAE IN WESTERN ATLANTIC. — Range extensions for juveniles of two species of Cymatiidae found on navigation buoys off South Carolina were reported by Merrill (1961, *Nautilus* 75 (3): 94-95). He postulated that the specimens were adventitious, that in their larval stage they had been carried northward of their normal range by the Gulf Stream, and therefore probably were unable to overwinter and reproduce at the higher latitude. This supposition was strengthened by the fact that no Cymatiidae had been reported from bottom habitats north of southern Florida in the latest monograph (Clench and Turner, 1957, *Johnsonia* 3 (30): 189-244).

The occurrence of larval cymatiids in the Gulf Stream north of their reported range can now be documented. Dr. Rudolph Scheltema of the Woods Hole Oceanographic Institution has been collecting plankton extensively in the open waters of the Atlantic Ocean. He informs us (personal communication) that larval Cymatiidae are widely distributed in his collections over the North Atlantic. One species, probably *Cymatium parthenopeum*, was taken from a sample east of the Grand Banks at Latitude 47°30', much farther north than adults are recorded.

Mr. Richard Petit of Ocean Drive Beach, South Carolina brought to the attention of the senior author the fact that a shrimp trawler had dredged a live specimen of *Cymatium parthenopeum*,

93 mm. long, 40 miles offshore of McClellanville, South Carolina, in 40 fathoms, June 1962. This find stimulated extensive dredging by Merrill and Petit in the offshore waters of South Carolina. The work produced many new range extensions, most of which were several hundred miles northward from southern Florida. The first report of these extensions has been published (Merrill and Petit, *Nautilus* 79 (2): 58-66). In all, 5 species of *Cymatium* now have been reported from South Carolina.

Two species of *Cymatium* were later taken from the catch made by a trawler in January 1963, southeast of Cape Lookout, North Carolina, in 18-20 fathoms. Two specimens of *Cymatium parthenopeum* (Von Salis) 1793 measured 95 and 195 mm. (I.F.R., U.N.C. Moll. Coll. #1107.1 and 1107.2) and two specimens of *Cymatium poulsenii* (Mörch) measured 65 and 72 mm. (I.F.R., U.N.C. Moll. Coll. #1106.2 and 1106.1). The collections at Cape Lookout extended the known range of both species, which have been reported previously from South Carolina by Merrill and Petit (*op. cit.*).

In January 1965, during a surf clam cruise off Chincoteague Inlet, Virginia (Lat. N. 37°40'; Long. W. 75°15'), two shells of adult *Cymatium poulsenii*, both measuring about 75 mm., were dredged up from 12 fathoms. The shells were inhabited by hermit crabs; although worn they still possess color and texture and do not appear to be fossils. If adult specimens are found alive at this latitude it will represent a significant advance northward from Cape Hatteras. — ARTHUR S. MERRILL, Bureau of Commercial Fisheries, Biological Laboratory, Oxford, Maryland and HUGH S. PORTER, Institute of Fishery Research, University of North Carolina, Morehead City.

CORBICULA MANILENSIS (Philippi) in the Alabama River System. — *Corbicula* was first found in the Alabama River System in the Mobile River, 1 mile north of Bucks, Mobile Co., Alabama, in the spring of 1962 (*Nautilus* 77: 31). Adults were very abundant at this locality. They were found in lesser numbers several miles up the river at Chastang Bluff. During the fall of 1964 two young specimens were collected in the Alabama River at Claiborne (*Nautilus* 78: 106). In the fall of 1964, adults were found abundant in the Tombigbee River, at Ezells Fish Camp, east of Lavaca, Choctaw Co., Alabama.

During the fall of 1965, numerous localities in the lower Ala-

bama River system were visited to determine the extent of the distribution of *Corbicula*. In the Alabama River adults were found abundant at Choctaw Bluff, Clarke Co. One mile below Claiborne, Monroe Co., dead adults were abundant where they had been caught by lowering of the water level, but living immature specimens were common. In the Cahaba River a single dead shell was found on a sand bar 1.5 miles southwest of Sprott, Perry Co.

In the Tombigbee River adults were found abundant at McCarty's Ferry, southeast of Ararat; young were very abundant at Tuscahoma Landing, eastsoutheast of Butler, Choctaw Co. Numerous immature specimens were found at Lock no. 3, southeast of Whitfield; adults were abundant below the Demopolis Dam, 2 miles east of McDowell, Sumter Co. Several young specimens were found 1.5 miles northeast of Cochrane, Pickens Co. Twelve young specimens were collected in Sucarnochee Creek, east of Bellamy, Butler Co.

At Tuscahoma Landing only two adults were found but the bottom was literally paved with young, which indicates an extremely high rate of reproduction. Judging by the size modes it must require 4 or 5 years for them to reach maximum size. — LESLIE HUBRICHT.

HABITAT OF *EUPERA SINGLEYI* Pilsbry. — *Eupera singleyi* is known from rather scattered records from streams in the Gulf Coastal Plain. The paucity of records is due in part to the absence of collecting within its range, and also to a lack of understanding as to its habitat. *Eupera singleyi* rarely is found by sifting mud and sand, a procedure usually used for collecting other Sphaeriidae. It is usually found attached by byssi to the undersides of stones and water-lodged wood, but sometimes to the roots of trees and to aquatic plants.

In the aquarium they move about on top of the sand without leaving a furrow. They can readily crawl up the glass and suspend themselves from the surface to find a suitable place for attachment among floating plants. — LESLIE HUBRICHT.

A PORTABLE SHELL COLLECTION. — When I started collecting shells, I followed the usual practice of placing them in trays in the shallow drawers of a cabinet. This worked fine until I had to move. Packing them required a full week. Since my work would require

moving occasionally, it became necessary to find a means of storing the collection where the specimens would be readily available for study, but where they could be moved without laborious packing.

My solution of this problem consisted of using army plywood foot lockers for cabinets. The tops of these were fastened down and the fronts were opened and hinged so that the lockers could be stacked. All of the shells were put into vials or plastic boxes. To hold these, cartons were made of corrugated pasteboard 7 by 14 inches in size; the height varied with the size of the vials or plastic boxes they were to contain. This size carton would fit in four stacks in the foot lockers. Separators of card were made for the cartons to hold the vials in place and prevent breakage. These lockers when full were light enough so that they could be lifted and carried by one man without strain. The collection has been moved several times without any damage to the specimens.

The one disadvantage of this system is that all lots of a species cannot be kept together, because the different sizes of vials are in different cartons. A single specimen of a species would fit into one size vial and a large series would require another size, so that a species of which there were many lots could be in several sizes of vials or plastic boxes. In order to find a certain lot of a species, it was necessary to have a catalog. This consisted, under each species, of the collection number, county and state where collected, and the size of vial in which it was contained. With this any lot could be readily found. — LESLIE HUBRIGHT.

RECORDS FOR PARABORNIA SQUILLINA. — Moore (1961. Gulf Research Reports, 1(1), 58 pp.) noted a small bivalve which was tentatively referred to the genus "Lepton" on the stomatopod crustacean, *Lysiosquilla scabricauda* (Lamarck), in Mississippi. Boss (1965. Amer. Mus. Novitates, no. 2215, 11 pp., 3 figs.) described *Parabornia squillina* as a commensal erycinid attached to the ventral surface of the abdomen and thorax of *L. scabricauda* from the Caribbean coast of Panama. Boss ([in press]. Malacologia. Symbiotic Erycinacean Bivalves) indicated that Moore's "Lepton" is *P. squillina*. The present note is to record additional specimens and measurements of *P. squillina* and to document its range. Four specimens of this bivalve were taken by W. Demoran from *L. scabricauda* collected at Horn Island, Mississippi, and another six individuals were recovered in the same area from *L. scabricauda* col-

lected at Dog Keys Pass, Mississippi. Two of the specimens are larger than any in the type series and are 7.48 mm. \times 4.90 mm. \times 2.28 mm. and 7.32 mm. \times 4.88 mm. \times 2.28 mm. respectively. — D. R. MOORE, Institute of Marine Science, University of Miami, Miami, Florida, and K. J. Boss, Ichthyological Laboratory, Bureau of Commercial Fisheries, Washington, D. C. Contribution No. 673 from the Marine Laboratory, Institute of Marine Science, University of Miami.

RANGE AND BATHYMETRIC EXTENSIONS FOR *OLIVELLA INCONSPICUA* AND *NASSARIUS LIMACINUS*. — *Olivella (Minioliva) inconspicua* (C. B. Adams, 1852), apparently has never been collected outside of Panama. Lowe reported what he considered to be this species from La Paz, Baja California, but his specimens are *Olivella alba* (Marrat, 1871). Adam's specimens were taken from beach drift, which Olsson states, came from near the city wall.

While aboard the Mexican shrimp trawler, "Jose Antonio," during July, 1963, I collected 11 specimens of *Olivella inconspicua* trawled from a depth of 60-70 meters about 20 miles off Bara del Suchiate, Chiapas, West Mexico. (Latitude 14° 24' North; Longitude 92° 32' West.)

All the specimens were extricated from the stomach of a single "sand" starfish. The soft parts of the shells were present in each specimen.

Several days later, while trawling off the Oaxaca coast near Bahia de Rosario, additional specimens of *Olivella inconspicua* were obtained which came up with mud and decaying vegetation. These were, however, quite worn.

Nassarius limacinus (Dall, 1917), described from the "Gulf of California in shallow water" has been reported by Coan as far south as Mazatlan. Two specimens were taken from the stomach contents of the same starfish mentioned above, thus extending the range south to the Mexico-Guatemala border.

Those who dredge or trawl for shells frequently have to dispose of starfish, and these are usually tossed overboard. I have found them to be a very important source for fresh, well preserved specimens of many rare species of mollusks.

The rays are mostly devoid of shells and can easily be broken off or removed with a knife. The remainder is placed in alcohol for later examination. If allowed to air dry, the contracting starfish

tissue will sometimes crush fragile pelecypods they have engulfed. — DONALD R. SHASKY, Research Associate, Los Angeles County Museum.

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PANOPEA BITRUNCATA (CONRAD). — A very large example of this species (a single, right valve) was presented to the Museum of Comparative Zoology by Mr. Riley Black of Fort Myers, Florida. This valve was brought up in a shrimp net from 10 fathoms, east of South Pass, Mississippi River, Louisiana, in June, 1965. This valve was but recently dead and measured 225 mm. in length and 147 mm. in height. — W. J. CLENCH.

BURCH COLLECTION. — The shells and the library remain in our possession with the thought that we may now have time to work on it. We wish to take this opportunity to give our sincere thanks to the host of customers and friends who have supported us over the years.

We have sold our entire stock and specimen shell business, but will continue dealing in books only. Our successor is: Mr. Richard E. Petit, P. O. Box 133, Ocean Drive Beach, South Carolina 29582, who will continue our mail order business in specimen shells.

Mr. Petit will at this time honor the prices in our list 551, only until he publishes his own first list. We are referring all orders to him. It may take a few weeks for him to get the stock arranged and orders filled.

The new owner will also publish the 1966 Directory of Concholo-

gists. Please send additional names and data to him. We hope that our collectors around the world who have been sending fine shells to us will continue to deal with Mr. Petit. We wish our successor the very best. — JOHN Q. AND ROSE L. BURCH, 4206 Halldale Ave., Los Angeles, Calif. 90062.

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No. 2

REINSTATEMENT OF MELARHAPHE MENKE, 1828

By JOSEPH ROSEWATER

U. S. National Museum, Washington, D. C.

The vicissitudes of the International Code of Zoological Nomenclature will require taxonomists for some time to come, to give constant attention to keeping current the names even of our well known mollusks. While preparing a catalogue of Littorinidae, prior to reviewing the classification of Indo-Pacific species, I was reminded of the effect on this group of the recent change in I.C.Z.N. Article 11 (d) (2nd edition, 1964).

Following the rules then in effect, McMichael (1959) pointed out that *Melarhapse* Menke, 1828, was introduced in synonymy, was therefore invalid, and should be replaced by *Melarapha* Cristofori and Jan, 1832. Rehder (1962) indicated that *Melarapha* Cristofori and Jan, 1832, and its use by Jan. 1830, are essentially nomina nuda, since no valid species names were included, nor were descriptions given. As a result, Rehder suggested the use of *Melarapha* A. and J. B. Villa, 1841, who cited several recognizable species. However, the latest edition of the code circumvents the need for this action. The new article 11 (d) (loc. cit.) stipulates that a name originally published as a synonym is not available unless before 1961 it was treated as an available name under its original date and authorship, and either used as the name of a taxon or as a senior homonym. Presumably this new interpretation will serve the best interests of stability of nomenclature. Nevertheless, it will create initial confusion where workers have acted to correct what previously appeared to be flaws in usage.

In conformance with this article, as revised, *Melarhapse* Menke, 1828, is valid and was used by Dall (1909), Iredale (1912), Winckworth (1922), Abbott (1954), and by others before 1961. The type species of *Melarhapse* has been quoted as: *Melarhapse glabrata* Mühlfeld = *Paludina glabrata* Ziegler = *Littorina neritoides* (Linnaeus, 1758). The first two are manuscript species names as is another name included by Menke (1828), *T. rupestris* Chabrier, although the name attributed to Ziegler was described by Pfeiffer

(1828). In fact, the only valid name included with the original citation of *Melarthaphe* is *Turbo coerulescens* Lamarck [*caerulescens*], which must be considered the type species by monotypy. This does not alter the concept of *Melarthaphe* because *T. caerulescens* is a synonym of *L. neritoides*, the well known European species.

The question of the value of some generic groups in Littorinidae remains to be settled. At present such taxons as *Melarthaphe* are differentiated largely on morphology of egg capsules and of the verge and on minute differences in shell anatomy. But one may argue that these characters are as much a matter of species differences as they are of generic significance. Both Winckworth and McMichael (loc. cit.) suggested that subgeneric versus generic allocations of these taxons still remains a matter of opinion. Further study may provide more evidence by which these distinctions may be interpreted. The purpose of the preceding note is to call attention to the correct name for one of these taxons commonly recognized today.

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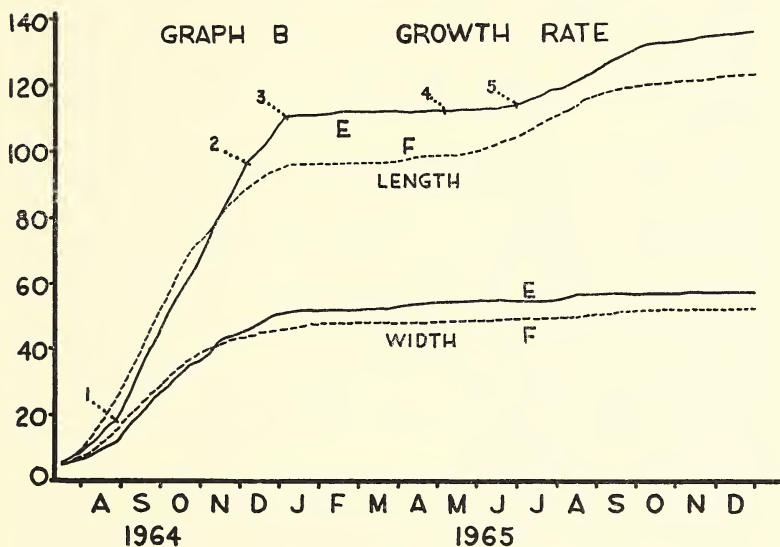
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-

LIFE HISTORY AND POPULATION STUDIES OF ACHATINA FULICA

By WILLARD KEKAUOHA

[Continued from July number]

Growth, aestivation, self-fertilization. On July 12, 1964, 24 infants of 377 hatched eggs laid by snail AQ were isolated individually for the following purposes: (a) growth rate studies and (b) observations on self-fertilization. Three months later the 24 were reduced to 8 (snails A to H) to reduce the work load.



The results to date (December 29, 1965, Graph B) are as follows: 1. *Growth*. Periods in the rate of growth were found to parallel Kondo's study (1964) in most respects. Snail E grew in length from 5.5 mm. to 132.5 mm. in 1 year 170 days (535 days), a total of 127.0 mm. (a) Infant growth (to point 1) was confirmed. Kondo, 9 mm. in 35 days; Kekaouha, 16.5 mm. in 41 days. (b) Adolescence (to point 2). Kondo, 74 mm. in 94 days; Kekaouha, 73.8 mm. in 95 days. (c) Young adult (point 2 to point 4). Kondo did not define exactly the period called young adult. He said in personal conversation that no arbitrary span can be obtained by the growth curve but a period between the end of adolescence (4 months) and the eighth month should suffice for our purposes.

According to the plotted graphs, specimen E grew from 81 mm. to 111 during that period (December 5 to February 10, 17 mm. in 120 days). In specimen E (point 3) there was a sudden stoppage in growth in 175 days which was expressed also in specimen F. (d) Maturity (point 4 to point 5). Growth levels off then, curiously, takes a gradual upswing from point 5 to end of curve. (e) Width, same as Kondo's.

Aestivation. None of the 8 specimens (snails A to H) went into aestivation in the 18 months period, in contrast to Ghose's and Kondo's reports of aestivation in their laboratory snails. Similarly, none of the original four (#3, 4, AQ, BB) obtained in the wild condition (in order to procure studies in ovulation and infants for growth and other studies) aestivated during their 18 months of captivity.

Self-fertilization. Three hundred and fourteen days after isolation (May 27, 1965) snails C (94.2 mm.) and D (102.7 mm.) were accidentally placed together by a neighbor's child. They copulated on May 28th; were separated and isolated on May 29th. Snail C laid 3 clutches of eggs while snail D laid 4 clutches, with viability ranging from 92.8 to 97.8%. Mortality rates will be studied from the progenies of snails C and D and one clutch is being kept together until egg-laying begins. The other 6 isolated virgin snails (snails A, B, E, F, G, H) are still under observation. None have laid eggs after 17½ months.

Two significant points must be cited here, namely, (a) the accidental mix-up of snails C and D provided a control for observations on virgins A, B, E, F, G, H and (b) isolation of individuals from infancy seems to provide evidence that copulation is necessary for production of fertile eggs. However, it is premature to conclude from this evidence alone that self-fertilization does not occur in *A. fulica*. This experiment must be continued 2 or 3 years longer.

Population study. A population study was first suggested by Dr. Yoshio Kondo in March 1963. Twenty separate meter-square plots were selected at random in May and June, 1963 in an area between Laie and Kahuku, Oahu. All individuals within these plots were grouped into 5 categories of size and data tabulated (Table V).

By random sampling, an *Achatina* population was approximated at 537,600 snails for the whole 67,200 square meter area, or approximately 8 snails per square meter plot. A follow-up census

made in June 1964, using the same procedures, showed a total population of approximately 403,200 snails for the same area, or approximately 6 snails per square meter plot, a decrease of approximately one-fourth.

TABLE V

<u>POPULATION</u>	<u>STUDY</u>	
	<u>1963</u>	<u>1964</u>
Eggs (0-5 mm)	0	0
Infants (5-25 mm)	28	22
One-half Grown (25-40 mm)	1	23
Sub-adult (40-60 mm)	33	31
Adult (60 ⁺ mm)	93	53
TOTAL FOR 20 SQUARE METER PLOTS	155	129
AVERAGE PER SQUARE METER PLOT	7.75	6.45
ESTIMATED TOTAL FOR 67,200 SQUARE METER AREA	537,600	403,200

MATERIAL AND METHOD

1. *Ovulation studies.* For the study of ovulation, copulating pairs of *Achatina* were found in the evening of July 15, 1964 and marked. The next morning, 10 pairs of the snails still in copula were gathered, separated and isolated. Twenty additional snails in copula were gathered the following night and put into isolated compartments. On July 17, 1964, 14 more snails in copula were gathered and isolated. All 54 snails were measured, numbered and fed constantly with measurements of length taken every 10 days. Fifty of the 54 were killed and only 4 were kept (#3, 4, AQ, BB).

Preceding ovulation, a snail would burrow 1 to 3 inches into the soil and then deposit its eggs. Egg-laying took 1 to 4 days. After

TABLE VI

	<u>TEMPERATURE</u>		<u>RAINFALL</u>
<u>1964</u>	<u>LOW</u>	<u>HIGH</u>	<u>AVERAGE</u>
January	68.52	78.68	5.32
February	67.62	78.52	1.24
March	66.55	78.52	3.83
April	68.20	79.13	2.81
May	68.93	78.86	1.01
June	69.93	82.70	0.70
July	71.23	82.87	2.98
August	70.97	83.16	1.33
September	71.20	84.10	3.16
October	69.13	81.26	4.29
November	66.73	80.90	3.58
December	67.29	90.23	11.44
<u>1965</u>			
January	61.42	78.94	5.20
February	60.85	75.29	6.93
March	60.84	78.00	2.48
April	62.73	78.83	6.46
May	66.03	80.81	14.65
June	68.81	82.07	0.84
July	70.84	82.87	3.17
August	72.87	83.81	1.88
September	70.60	85.20	2.48
October	70.25	84.32	14.07
November	64.25	82.17	17.68
December	62.08	79.31	6.75

completion of egg-laying, a snail would rest from 3 hours to 3 days before normal activity was resumed. On a few occasions, snails would lay their clutch of eggs $\frac{1}{4}$ to $\frac{1}{2}$ inch into the soil with the main body of the eggs exposed and out of the soil. All eggs laid were removed, counted and separated for viability studies. When

the infants emerged from their eggs, they were removed and housed in a separate container.

Normal eggs are approximately 5 x 4 mm. in size. However, on all occasions during the 1964 laying, one to six infertile pearl-like eggs 2 x 2 to 4 x 4 mm. in size were found with each clutch (with the exception of snail #4, first clutch). In the 1965 egg-laying of snail #4, large eggs, 6.5 x 5.5 mm. were found.

2. *Food.* Food consisted mainly of lettuce with an occasional diet of papaya, apple, cabbage and broccoli. Fresh food was placed with the snail every 3 to 4 days and decayed vegetable matter removed.

3. *Temperature.* The temperature varied from a low of 66.55° to a high of 90.23° for 1964 while the temperature for 1965 varied from 60.84° to 85.20° F.

4. *Rainfall.* Rainfall varied from an average monthly low of 0.70 inches in June 1964 to a high of 17.68 inches in November 1965. There seems to be no correlation between rainfall and egg production.

5. *Moisture.* All compartments were sprinkled with water every 3 to 4 days to keep them wet and moist.

6. *Measurements.* During infancy, a cardboard caliper was used to prevent injury to the shell. When the snails were approximately 30 mm. in length, a metal caliper was used. When specimens grew too large for these calipers (approximately 115 mm.) a cranial caliper was used for the measurement of length only.

SUMMARY

1. *Egg-laying season determined by the smash technique.* The egg-laying season for 1964 was from June to December while the 1965 season was from May to November.

2. *Multiple ovulation.* Snails kept in captivity laid five to six clutches of eggs during their 1964 season from July 5, 1964 to January 22, 1965.

3. *Period between ovulation.* The period between ovulation varied from 20 days to 91 days with an average of 34 days.

4. *Number of eggs per clutch.* Egg clutches varied from 17 to 442 eggs per clutch with an average of 213 eggs per clutch.

5. *Capacity of eggs per individual.* The capacity of eggs were 677, 776, 1624 and 1817 eggs per individual per season.

6. *Viability of eggs.* Viability of egg clutches varied from 0% to

100% with an overall viability of 93.1%.

7. *Aborted eggs.* Results from the study of viability of aborted eggs show that eggs with any shade of yellow were 50 to 70% viable; and that eggs aborted from a single individual varied in color with dark yellow eggs having a higher viability than light yellow eggs.

8. *Growth.* Snail E grew in length from 5.5 mm. to 132.5 mm. in 535 days, a total of 127.0 mm. and from 4.5 to 55.7 mm. in width, which parallels Kondo's (1964) findings in most respects.

9. *Aestivation.* None of the 8 specimens raised from infancy, or the 4 original snails obtained from the natural environment aestivated during their 18 months of isolation and captivity.

10. *Self-fertilization.* An accidental mix-up of 2 specimens provided a control producing fertile eggs while 6 others still in isolation since infancy have not produced any eggs (17 months).

11. *Population studies.* Random sampling in 1963 showed a total population of approximately 537,600 snails, or approximately 8 snails per square meter plot. A 1964 census showed approximately 403,200 snails, or approximately 6 snails per square meter plot, a decrease of approximately one-fourth.

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THREE NEW SONORELLA FROM SOUTHWEST ARIZONA

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In early 1918, James H. Ferriss explored for mollusks in the area west of Tucson, Arizona, as far as Ajo. He stated that the large Growler Range west of Ajo city looked promising from a distance, but the Mexican bandits were active at that time along the western boundary. This was apparently sufficient deterrence, even for an ardent collector like Ferriss. The most western locality for *Sonorella* on that trip turned out to be "3 miles west of Comovo Church" (now Kom Vo) in the Papago Indian Reservation.

In recent years, explorations for mollusks have been resumed in this general area. Snails have been brought to the University of Arizona from the Organ Pipe National Monument, the Cabeza Prieta Game Range, and the Picacho Mts. They are described below.

SONORELLA BABOQUIVARIENSIS COSSI new subspecies. Plate 1, figs. A-C.

Description: Shell depressed-globose, heliciform, thin, glossy, light brown, with a chestnut-brown spiral band on the well rounded shoulder; narrowly and half-covered umbilicate, the umbilicus contained about 13 times in the diameter. Embryonic shell of about $1\frac{1}{4}$ whorls, with apical sculpture like *S. hachitana*. First half whorl irregularly radially wrinkled only, the remainder of the embryonic shell with forwardly descending spiral threads superimposed on the radial sculpture. First $2\frac{1}{2}$ whorls, including embryonic whorls, show scars of worn off, hair-like periostracal projections. Remaining whorls with faint, raised growth striae, with a silky luster. Body whorl descending only slightly to the narrowly expanded peristome. The columellar margin of the peristome is broadly expanded and reflexed to cover nearly half of the umbilicus. Aperture oblique, large, broadly ovate, its width more than

half the diameter of the shell; with a thin parietal callus.

Holotype measurements: Height 11.7 mm.; max. diam. 19.2 mm.; umbilicus 1.5 mm.; whorls $4\frac{1}{2}$.

Genitalia of holotype (Plate 2, fig. A): The penis contains a relatively small cylindric verge with a blunt, rounded end. The epiphallus is only slightly longer than the penis and bears a long (for the genus), well detached, epiphallic caecum. The penial retractor inserts on the epiphallus a short distance above the penis. Penial sheath relatively long, about half the length of the penis. The vagina is about as long as the penis and about twice as long as the free oviduct.

Measurements of
genitalia, in mm.

	Holotype	Paratype A	Paratype C
Penis	8.0	7.0	6.0
Verge	2.5	2.5	2.5
Penial sheath	3.5	4.5	4.5
Epiphallus	9.0	8.0	8.5
Epiphallic caecum	1.0	1.0	1.5
Vagina	8.0	9.0	7.5
Free oviduct	4.0	4.0	4.0

Type locality: Ajo Range, Organ Pipe Cactus National Monument, Pima Co., Arizona, in rockslide along left bank of Arch canyon, at base of north facing cliffs about $\frac{1}{2}$ mile upstream from the Arch; elevation ca. 2900 ft. (J. Bequaert and W. B. Miller, 25 Jan. 1965). Holotype ANSP. (308955). Paratypes in collections of ANSP. (308956), Dept. of Zoology, University of Arizona (879), and the author (4745).

Other localities: Upper Arch canyon, Ajo Range, elev. ca. 3500 ft. to 4000 ft. (Harold T. Coss, 12 April 1965). Cave in saddle about $\frac{1}{4}$ mile south of the Arch in Arch canyon (Harold T. Coss and Jim Taylor, 6 Feb. 1966).

In shell characteristics, this subspecies is not distinguishable from small forms of *S. baboquivariensis* s.s. The smallest paratype measures: height 11.2 mm.; max. diam. 17.2 mm.; umbilicus 1.3 mm.; whorls $4\frac{1}{2}$. The largest paratype measures: height 12.3 mm.; max. diam. 19.5 mm.; umbilicus 1.6 mm.; whorls $4\frac{1}{2}$. Specimens of *cossi* from upper Arch canyon ran even smaller, with max. diam. as low as 15.0 mm. In embryonic sculpture, *cossi* displays the protractive spiral threads consistently in all specimens examined, where the apical sculpture was not completely worn off. Some fresh young shells also show ascending spiral threads on the embryonic whorls.

In the genitalia, *cosi* differs significantly and consistently from *baboquivariensis* s.s. The verge is smaller, ca. $\frac{1}{3}$ the length of the penis, and does not have a swollen, glandiform tip. The vagina is as long as or longer than the penis, and the epiphallic caecum is particularly long and detached (for the genus).

Since the shell characteristics are so similar to those of *baboquivariensis* s.s., only a subspecific distinction seems indicated. Hybridization experiments between the nominate species and *cosi* are planned; if they reveal evidence that potential interbreeding between them no longer exists, this subspecies would have to be raised to specific rank.

The subspecies is named after Mr. Harold T. Coss of the National Park Service who was stationed at the Organ Pipe National Monument in 1965 and brought in the first specimens of this snail to the University of Arizona. For some time, this was the westernmost known population of *Sonorella* in southwestern Arizona, until further explorations revealed other populations farther west (*vide infra*).

SONORELLA SIMMONSI new species.

Plate 1, figs D-F.

Description: Shell depressed, heliciform, thin to solid, glossy, light brown, with chestnut brown spiral band on the well rounded shoulder; umbilicate, the umbilicus contained 8 to 9 times in the diameter. Embryonic shell of about 1 and $\frac{1}{3}$ whorls, with sculpture like *S. hachitana*; its apex smooth; the remainder with weak, irregular radial wrinkles and fine, spirally arranged, hyphen-like papillae which anastomose over the last third of the embryonic shell into thin, forwardly descending threads. Later whorls have light growth lines with occasional papillae at first, the papillae disappearing on the body whorl. Body whorl smooth, with a silky luster. Aperture oblique, rounded, slightly wider than high. Peristome expanded, the margins converging; parietal callus thin.

Holotype measurements: Height 12.0 mm.; max. diam. 20.6 mm.; umbilicus 2.6 mm.; whorls 5.

Genitalia of holotype (Plate 2, fig. C): Penis large and thick, equally thick throughout. A short, thick penial sheath envelops its base. The verge is nearly as long as the penis, moderately thick, its largest diameter at about $\frac{1}{3}$ of its length from the epiphallus, then slowly tapering toward the abruptly truncate tip, indistinctly annulate. The slender epiphallus is as long as the penis and bears

the retractor muscle near its distal end; near its proximal end, it is invested by connective tissue from the upper end of the penial sheath. Epiphallic caecum small, only slightly detached from the epiphallus. Vagina $\frac{2}{3}$ to $\frac{3}{4}$ the length of the penis, about 3 times as long as the free oviduct.

Measurements of
genitalia, in mm.

	Holotype	Paratype A	Paratype B
Penis	15.0	13.0	13.0
Verge	11.0	10.5	11.0
Penial sheath	2.5	2.5	2.5
Epiphallus	18.5	18.0	20.0
Epiphallic caecum	1.0	0.5	1.0
Vagina	11.5	9.5	7.0
Free oviduct	3.0	4.0	3.0

Type locality: Picacho Mts., Pima Co., Arizona, in north facing rock piles on west side of canyon which runs southeasterly from Newman Peak, R 9 E, T 8 S, Sec. 26, SE $\frac{1}{4}$; elevation ca. 2500 ft. (J. Bequaert, M. L. Walton, W. N. Miller, and W. B. Miller, 27 Dec. 1965). Holotype ANSP. (308953). Paratypes in collections of ANSP. (308954), Dept. of Zoology, University of Arizona (1628), M. L. Walton (9245), and the author (4842).

The embryonic spiral threads vary in intensity, but are present at least to some degree on all specimens examined. Shell color varies from light brown to nearly white. One fresh specimen had no band at all and was completely white. There is a large variation in maximum diameter. The smallest paratype measured as follows: height 11.2 mm.; max. diam. 17.8 mm.; umbilicus 2.0 mm.; whorls $4\frac{3}{4}$. The largest paratype measured: height 12.7 mm.; max. diam. 22.1 mm.; umbilicus 2.6 mm.; whorls 5.

The shell of *S. simmonsii* has the general appearance of certain forms of *S. ambigua* from the Roskrige Mts., about 35 miles to the south, as well as some specimens of *S. sitiens* from the Ko Vaya hills (Cababi Mts.) about 55 miles to the southwest. It is readily distinguishable from these by the presence of spiral threads on the embryonic whorls. In the genitalia, it bears some resemblance to *S. ambigua* in the large, thick penis and verge. The shape of the verge differs, however, in that it slowly tapers for the last $\frac{2}{3}$ of its length to an abruptly truncate tip, while *ambigua* has a club-shaped verge with maximum diameter at the short-conic tip. Other differences are in the penial sheath, which is ca. $\frac{1}{6}$ the length of the penis in *simmonsii* and ca. $\frac{1}{3}$ in *ambigua*, the epiphallus, which is

ca. $1\frac{1}{2}$ times the length of the penis in *simmons*i and ca. $\frac{2}{3}$ to $\frac{3}{4}$ in *ambigua*, and the vagina, which is ca. $\frac{2}{3}$ to $\frac{3}{4}$ the length of the penis in *simmons*i, while it is about as long as the penis in *ambigua*.

Dead shells were collected by Mr. Norman M. Simmons of the Fish and Wildlife Service, while hunting in the Picacho Mts. and brought to the University of Arizona for identification. Subsequently, on 27 Dec. 1965, the author, accompanied by Dr. Joseph Bequaert, Mr. Munroe Walton, and the author's son, W. Nixon Miller, collected large numbers of live specimens and dead shells at the type locality. The holotype was selected from among the live adults, and all other specimens collected on this expedition have been designated paratypes.

It is probable that this snail is widespread in the Picacho Mts. Mr. Simmons stated that he had found shells in several other canyons in these mountains. This species is named for Mr. Simmons, whose interest in all branches of natural history was responsible for bringing this new species to the author's attention.

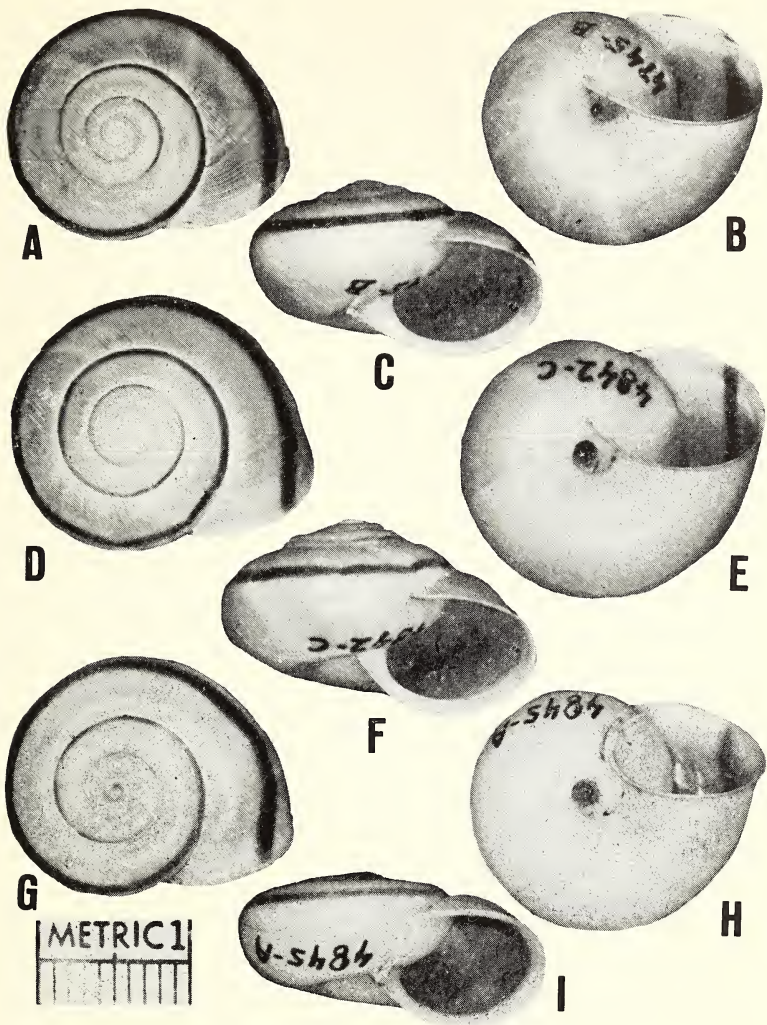
SONORELLA MEADI new species.

Plate 1, figs. G-I.

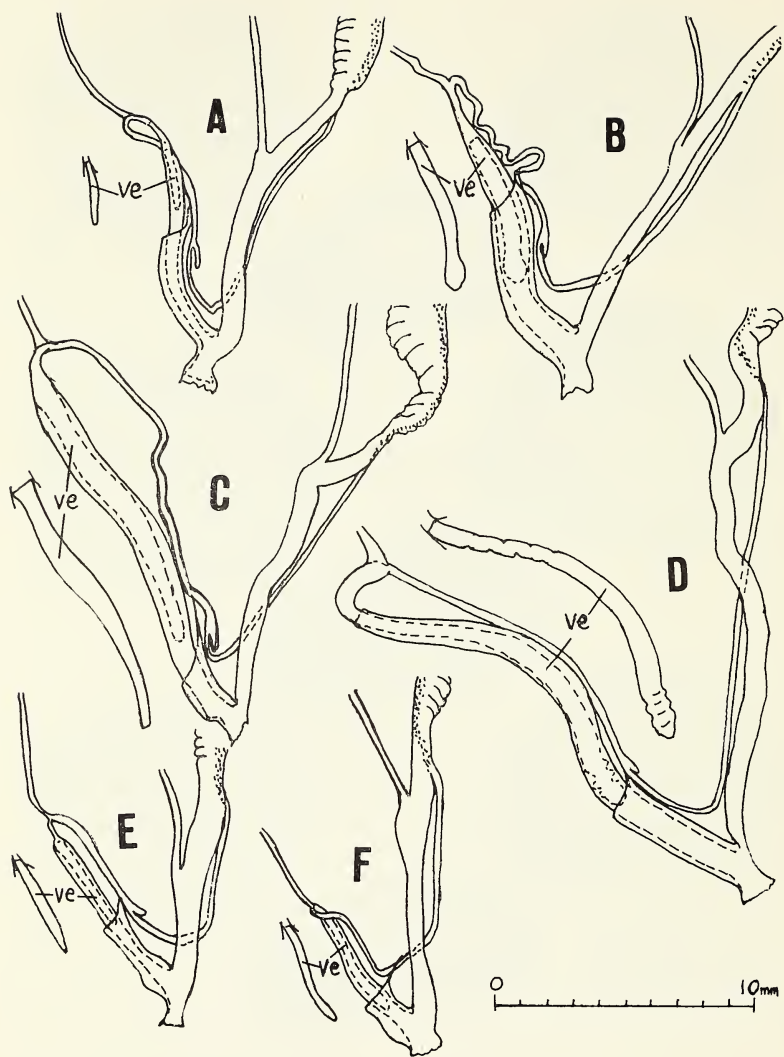
Description: Shell strongly depressed, heliciform, solid, glossy, light tan, fading to nearly white around the umbilicus, with a chestnut brown spiral band on the well rounded shoulder; widely umbilicate, the umbilicus contained 6 to 7 times in the diameter. Embryonic shell of about 1 and $\frac{1}{3}$ whorls, with sculpture of the *hachitana* type. Apex smooth, followed by an area of weak, irregular radial wrinkles; after the first half whorl, hyphen-like papillae are superimposed over the radial wrinkles. Over the last third of the embryonic shell, the hyphen-like papillae are elongated and run together to form forwardly descending spiral threads. Post-embryonic whorls with small papillae superimposed on weak radial wrinkles, the papillae numerous on the early whorls, gradually disappearing, and finally absent on the body whorl. Body whorl with faint spiral lines impressed on the shoulder between the chestnut-brown band and the suture. Body whorl descends shortly to the moderately expanded peristome. Aperture oblique, rounded-oval, slightly wider than high, with a moderately thick parietal callus.

Holotype measurements: Height 9.7 mm.; max. diam. 20.2 mm.; umbilicus 3.0 mm.; whorls $4\frac{1}{2}$.

Genitalia of holotype (Plate 2, fig. E): The penis contains a



Holotypes. A-C. *Sonorella baboquivariensis cossi* W. B. Miller D-F. *S. simonsi* W. B. Miller. G-I. *S. meadi* W. B. Miller.



Lower genitalia. A. *S. baboquivariensis cossi* W. B. Miller. B. *S. baboquivariensis* Pilsbry & Ferriss, Saucito ridge, Baboquivari Mts. C. *S. simmonsii* W. B. Miller. D. *S. ambigua* Pilsbry & Ferriss, Coyote Mts. E. *S. meadi* W. B. Miller. F. *S. eremita* Pilsbry & Ferriss, "San Xavier Hill" (type loc.). ve: verge. All drawings to same scale, drawn from stained whole mounts.

long thin verge with a narrow, pointed tip. The epiphallus is slightly shorter than the penis and bears a short, only slightly detached caecum. The penial retractor is inserted on the epiphallus a short distance above the penis. The penial sheath is about half the length of the penis. The vagina is about half the length of the penis and about equal to the length of the free oviduct.

Measurements of

genitalia, in mm.:	Holotype	Paratype B	Paratype C
Penis	7.0	7.5	8.0
Verge	5.0	4.0	5.0
Penial sheath	3.5	3.5	4.0
Epiphallus	6.0	6.5	6.5
Epiphallic caecum	0.3	0.5	0.5
Vagina	4.0	3.5	3.0
Free oviduct	3.0	4.0	3.0

Type locality: Agua Dulce Mts., Pima Co., Arizona, in rock piles in canyons both south and north of Agua Dulce Pass, east of Quitovaguita Peak; elevation ca. 1600 ft. (W. N. Miller and W. B. Miller, 29 Jan. 1966). Holotype ANSP. (308951). Paratypes in collections of ANSP. (308952), Dept. of Zoology, University of Arizona (2301), and the author (4845).

The spiral lines impressed on the body whorl vary in intensity from prominent to absent; on the holotype, they are present but faint. Two paratypes are completely bandless and white, although fresh and lustrous. The smallest of the paratypes measures: height 9.4 mm.; max. diam. 18.1 mm.; umbilicus 2.3 mm.; whorls $4\frac{1}{4}$. The largest of the paratypes measures: height 10.4 mm.; max. diam. 21.9 mm.; umbilicus 3.7 mm.; whorls $4\frac{1}{2}$.

In shell characteristics as well as genitalia, this species appears to be most closely related to *S. eremita* P. & F. from the Mineral Hills about 120 miles to the east. In general *meadi* is more depressed than *eremita* and the embryonic sculpture of spiral threads is not so well developed. In the genitalia, *meadi* does not have the basal swelling of the penis which is present in *eremita*; the long verge is narrowly pointed instead of rounded; and the vagina is much shorter than the penis, instead of longer as in *eremita*. *S. meadi* is not closely related to the neighboring populations of *S. baboquivariensis cossi* W. B. Miller of the Ajo Mts., nor to *S. ambigua* P. & F. of the hills just west of Kom Vo.

A dead shell which appears referable to this species was collected by Mr. Harold T. Coss, of the National Park Service, in the Bates

Mts. in the Organ Pipe National Monument on 23 Jan. 1966. Live material will be necessary before a firm diagnosis of this population can be made. Supposedly this species extends to the north and east into the Bates Mts., the Growler Mts., the Little Ajo Mts., and possibly the Saucedo Mts. The Sierra Pinta to the west and the Sierra del Pozo to the southeast are the abodes of races of *Micrarionta* (*Eremarionta*) *rowelli*.

The Agua Dulce Mts. have been erroneously marked on certain topographic maps as located within the Organ Pipe National Monument. The 1964, 15 minute series Agua Dulce quadrangle shows them correctly located just west of the Monument.

This locality represents the westernmost locality for *Sonorella* in southern Arizona. It also represents one of the lowest habitats for the genus. The vegetation is indicative of the Lower Sonoran life zone, consisting primarily of saguaro, organ pipe cactus, small-leaved palo verde, chuparosa, and desert lavender.

This species is named after Dr. Albert R. Mead, an eminent malacologist, who enabled the author to devote full time to the study of zoology in general and *Sonorella* in particular.

A NEW SPECIES OF KALENDYMA FROM MALAITA, SOLOMON ISLANDS

By WILLIAM J. CLENCH

The species described below is the second known species in the genus *Kalendyma*. This genus was introduced by Gude for *Helix compluviatus* Cox, a rather remarkable land mollusk now placed in the Ariophantidae. The distinguishing character is a deep spiral groove which is developed a little above the whorl periphery. It is initiated just beyond the protoconch. Its function is unknown as the soft anatomy has never been studied.

The specific locality for *H. compluviatus* was unknown to Cox who had given only the "Solomon Islands" as its type locality. We have specimens collected in 1949 by J. R. Hood from "head of the Tenaru River, Guadalcanal Id., Solomon Islands at 1000 feet," so this island can be accepted as the type locality.

ARIOPHANTIDAE

KALENDYMA Gude

Kalendyma Gude, 1911, Proc. Malac. Soc. London 9:273 (type species, *Helix compluviatus* Cox).

KALENDYMA COMPLUVIATA (Cox)

Helix compluviatus Cox, 1871 [1872], Proc. Zool. Soc. London, p. 646, pl. 52, fig. 10 (Solomon Islands).

KALENDYMA VANDERRIETI, new species. Plate 3, figs. 1-2.

Holotype. Mus. Comp. Zool. 260885, from Ataa, Malaita Island, Solomon Islands. Rev. J. Vander Riet collector, 1965.

Paratype. Mus. Comp. Zool. 260886, from the same locality as the holotype.

Description. Shell depressed, minutely umbilicate, nearly smooth, shining and reaching about 12 mm. in greater diameter. Color a uniform brown. Whorls $5\frac{1}{2}$, convex, a little less so above the spiral groove. Spire depressed, dome-shaped and forming an angle of about 140° . Aperture auricular in outline. Outer lip simple with a slight reflection at the base near the columella. Umbilicus very small and partially concealed by the reflection of the columella. Suture deeply indented. Sculpture consisting of numerous, flattened, axial ridges above the spiral groove, and exceedingly fine growth lines below the groove. A little above the whorl periphery there is developed a spiral groove, deeply indented on the outside and forming a ridge inside.

Measurements

Height	Gt. Diameter	Less. Diameter	
mm.	mm.	mm.	
7.5	12.5	12	Holotype
7.3	12.2	10.5	Paratype

Remarks. This new species differs mainly in size from that of *K. compluviata*. This latter species has 5 whorls and is 30 mm. in greater diameter, while *vanderrieti* has $5\frac{1}{2}$ whorls and is only 12.5 mm. in greater diameter. All other characters are similar.

FOUR NEW LAND SNAILS

BY LESLIE HUBRICHT

MESODON CLAUSUS TROSSULUS, new subspecies. Plate 3, fig. A-C.

The shell differs from that of *Mesodon clausus clausus* (Say) in having a broad reddish-brown revolving band just above the periphery. This band was present in all specimens collected and in all dead and immature shells seen.

Ht. 10.0 mm., Diam. 14.1 mm., Ap. Ht. 6.9 mm., Ap. Diam. 8.2 mm. Holotype.

Type locality. Alabama: Clarke Co.: base of bluff of Baileys

Creek, 2.5 miles east of Gainestown, holotype, Field Museum of Natural History 152202, paratype 152203; other paratypes 34561, collection of the author.

GLYPHYALINIA LUTICOLA, new species.

Plate 3, fig.D-F.

Shell small, strongly depressed, coppery (when fresh), glossy, thin and transparent, spire very low conoid. Whorls 4 to 4.5, well rounded, gradually and uniformly increasing, sutures moderately impressed. Sculpture of rather widely spaced radial furrows (20 on the last whorl of the holotype) and fine spiral striae. Aperture lunate; lip thin, sinuous. Umbilicus rimate.

Height 2.6 mm., diameter 5.7 mm., aperture height 2.3 mm., aperture width 3.1 mm., 4.5 whorls. Holotype.

Animal slate colored. Penis rather short, claviform; retractor short and stout, attached to the side of the apical chamber so that there is a broad, rounded lobe above it. Epiphallus about 1.5 times as long as the penis, of uniform diameter except for a short taper at the ends, a little greater in diameter than the penis, attached near the center of the penis. Vagina very short. Free oviduct about 1.5 times as long as the penis. Spermatheca large, ovoid; duct about as long as the free oviduct, stout.

Egg with white calcareous shell, length 1.2 mm., diameter 0.9 mm.

Distribution. *Alabama:* Greene Co.: near Black Warrior River, north of Demopolis. Dallas Co.: near Cahaba River, east of Harrell. Sumter Co.: Black Bluff, 3 miles east of Whitfield. Choctow Co.: near Tuckabun Creek, 2.7 miles south of Pennington. Baldwin Co.: swamp, Lillian, holotype 147043 and paratypes 147044 F.M.N.H., other paratypes 33431, collection of the author. *Mississippi:* Clarke Co.: Basic City; wet woods, 1.5 miles southwest of Langsdale. Wayne Co.: near Turkey Creek, 8 miles east of Waynesboro. Lamar Co.: edge of swamp, 2 miles southeast of Lumberton. *Louisiana:* Tangipahoa Ph.: magnolia woods 1.3 miles west of Amite. Pointe Coupee Ph.: low woods, 3 miles southeast of Batchelor; low woods, 1.6 miles west of Torbert; low woods, 3 miles northwest of Lettsworth; low woods, 1.9 miles west of New Roads. East Baton Rouge Ph.: roadside, 4800 Laurel St., Baton Rouge; low woods, Duncan Point, south of Baton Rouge; low woods, 6 miles south of Baton Rouge. West Baton Rouge Ph.: low woods, 1 mile west of Carey; low woods, 1 mile west of Port Allen. Evangeline Ph.: low woods, 6.4 miles east of Basile. Allan Ph.: along RR., Reeves; low woods,

2 miles east of Le Blanc; waste ground, 0.4 mile west of Le Blanc.

Glyphyalinia luticola may be readily distinguished from *G. indentata* by its coppery color. The umbilicus is smaller than is usually found in *G. indentata* within its range, and it is usually found in wetter habitats. It is a species of swamps, where it is frequently associated with *Vertigo* and *Catinella*.

GLYPHYALINIA PECKI, new species.

Plate 3, fig. G-I.

Shell small, strongly depressed, nearly transparent with a whitish wash, glossy, spire very low conoid. Whorls 4.5 to 5, well rounded, gradually and uniformly increasing, sutures moderately impressed. Sculpture of radial furrows which are followed by radial ridges, the furrows continue onto the base but not the ridges (about 60 furrows on the last whorl of holotype), and distinct spiral striae. Aperture lunate; lip thin, sinuous. Umbilicus very small, about 3.5% of the diameter of the shell.

Height 2.5 mm., diameter 5.7 mm., aperture height 2.1 mm., aperture width 2.7 mm., umbilicus diameter 0.2 mm., 4.5 whorls. Holotype.

Height 2.9 mm., diameter 5.9 mm., aperture height 2.3 mm., aperture width 2.9 mm., umbilicus diameter 0.2 mm., 5 whorls. Paratype.

Animal white and apparently blind. Penis rather short, claviform; retractor short and stout, attached terminally. Epiphallus about 1.5 times as long as the penis, of uniform diameter, distal end rounded, about twice the diameter of the penis, attached about three-fourths up on the penis. Vagina very short. Free oviduct about twice as long as the penis. Spermatheca fusiform, about as long as the penis; duct as long as the free oviduct, stout.

Distribution. *Alabama:* Jefferson Co.: in McClunney (Alabama Crystal) Cave, 2 miles west of Clay (Stewart B. Peck, coll.), holotype 147045 F.M.N.H., other paratypes 34487, collection of the author; in cave, $\frac{3}{4}$ mile northeast of McClunney Cave (Peck, coll.).

Glyphyalinia pecki differs from *Glyphyalinia indentata* (Say) to which it seems most closely related by the distinct ridge which follows the radial grooves. In this character it seems unique in the genus. It is known only from two caves in Jefferson County, Alabama.

HELICODISCUS HEXODON, new species.

Plate 3, fig. J-L.

Shell discoidal, spire flat or nearly so; whorls 5 to 5.5, yellowish,

translucent when young, becoming opaque with age. Umbilicus wide and shallow, showing all the whorls, occupying from 50 to 57% of the diameter of the shell. Whorls well rounded below, distinctly flattened above the periphery, slowly increasing, the last slowly descending; sutures well impressed; sculptured with numerous, fine, fimbriated lirae. Aperture lunate, the peristome simple, somewhat thickened within. Within the last quarter whorl there are usually 3 pairs of teeth on the outer and basal walls. These teeth are transversely elongate; the outer teeth are somewhat oblique, the upper end forward; the basal teeth are a little in front of their respective outer teeth, and have triangular bases, broadest near the parietal wall.

Height 1.9 mm., diameter 4.9 mm., umbilicus diameter 2.8 mm., aperture height 1.4 mm., 5.5 whorls. Holotype.

Type locality Tennessee: Bledsoe Co.: base of Walden Ridge, 2.5 miles southeast of Pikeville, holotype 147046, paratypes 147047, F.M.N.H., other paratypes 30918, collection of the author.

Helicodiscus hexodon is most closely related to *H. fimbriatus* Wetherby, differing in the uniformity of its lirae and fringes. In *H. fimbriatus* there are at least 3 lirae which are more prominent than the rest and the fringes are longer. It differs from *H. notius notius* Hubricht, with which it was found, in having higher whorls and in the flattened upper part of the body whorl, as well as in the form of the teeth.

TWO NEW SUBSPECIES OF POTAMOLITHUS

By J. J. PARODIZ

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In 1961 I collected typical *Potamolithus peristomatus* (Orb.) at Paso de la Patria, Paraná River near San Cosme, only 30 km. W. of the type locality (Itaty), province of Corrientes, Argentina. Although the species was often mentioned in the bibliography of the group, apparently it had not been collected since d'Orbigny; Pilsbry has not seen this species but he referred it in his key of 1896 (Nautilus, 10:87), which may give the impression of belonging to the materials collected by Dr. Rush in Uruguay. Corsi in 1900 (Anales Museo Nacional Montevideo, 2:335) also mentioned *peristomatus* from the Queguay River in Uruguay, but during our extensive collecting in that area not a single specimen was found.

However, a lot collected by myself on the Uruguay River, at San Javier, Misiones, Argentina, represents an allopatric form, here considered as a new subspecies:

POTAMOLITHUS PERISTOMATUS MISIONUM new subspecies. Figs. 1-4.
Plate 4.

Larger and longer than typical *peristomatus* (the smaller specimen 6.5 x 5 mm., and the larger 9 x 7 mm.). The spire is still very conic and acute as in *peristomatus peristomatus*, but the last whorl shows a greatly developed hump protruding on the left side (in front view), which corresponds to a broader and higher expansion in that area. The color is much darker, almost black.

Holotype (Carnegie Museum) 7 mm. long, 6.5 wide, from San Javier on the Uruguay River, Misiones.

The hump on the side and back of the shell gives to it a more distorted configuration than that often found in *P. rushi* (Pils.) which also differs in shape, color and other characteristics.

The allopatric populations of *peristomatus peristomatus* and *peristomatus misionum*, are from basins at present well isolated, due to drainage changes during the late Pliocene and Pleistocene, a case which is repeated in *Neocorbicula* and other fresh-water mollusks of that area.

Another very rare species is *Potamolithus felipponei* Ihering, the only specimen known is the type collected by Dr. Felippone at Montevideo. On the Argentine shore of the Uruguay River, 260 miles NW. of the type locality, I collected several specimens showing remarkable differences, here described as new subspecies:

POTAMOLITHUS FELIPPONEI CONCORDIANUS new subspecies. Fig. 6

Trochiform, conic-pyramidal, the spire forming an angle of 45° with the base, but shorter than in *felipponei felipponei* (fig. 5) and with flatter walls. Surface smooth, dark-olive with brown spiral band stronger marked than in *felipponei felipponei* (compared with Ihering' and Pilsbry's descriptions), which starts at the middle of the last whorl and becomes suprasutural in position in the upper whorls; another, but less conspicuous band, runs subsuturally; 4½ to 5 whorls, the last with a strong and oblique central keel running up to the suture and vanishing before reaching the penultimate whorl; on the periphery, at left, this keel marks the vertex of a right angle which divides the upper from the lower portion of the shell. Umbilical area depressed, with a second keel

surrounding it. Columellar area strongly bi-folded, with a large tooth-like prominence on the inner side, which is thick and chamfered; inner area of columella forming a groove or pit separating conspicuously the inner and outer sections. The aperture is very oblique, semicircular, angulate at the top and, in minor degree, at the base. Peristome thick, simple, without a notch below the suture and very little expanded. Suture well marked, especially at front by effect of the carina, but not deep.

Holotype: (Carnegie Museum) 3 mm. long, 2.5 mm. wide, apert. 1.7×1.3 mm. from Arroyo Yuquerí Grande at Concordia, province of Entre Rios, Argentina, coll. Parodiz 1961.

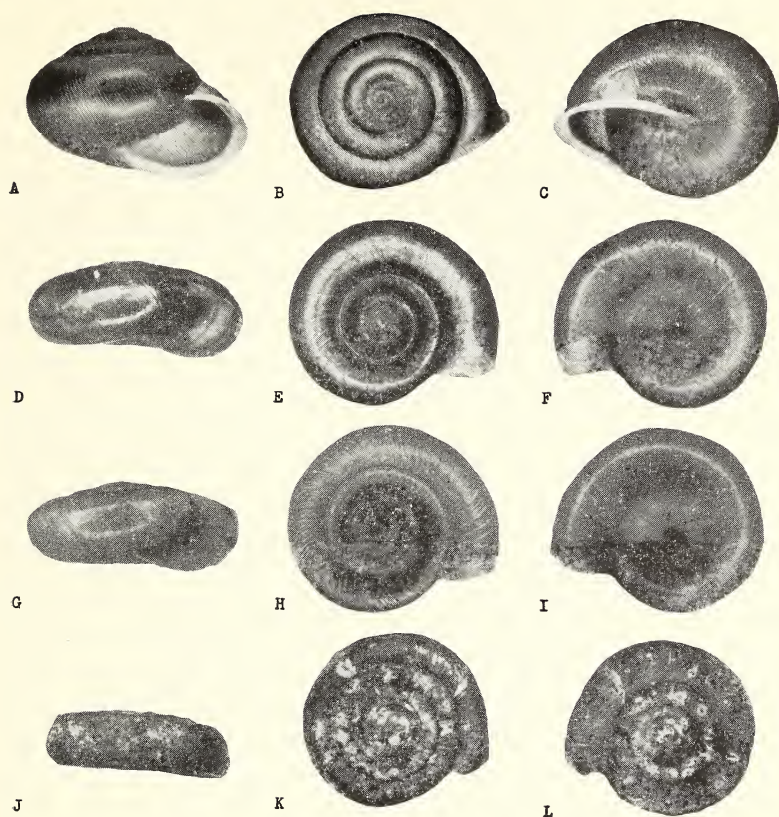
The spire (counting from its sutural base at the penultimate whorl) shortly less than $\frac{1}{5}$ of total length. Basal area extraordinarily large in relation to the size of the shell.

The small size of the shells, the thinness of the lip and, judging from similar characteristics offered by other species in their neanic stages, the specimens observed suggest some immature condition. However, they have such striking characteristics that unlikely would disappear in full adults: the lack of a strong marginated notch at the upper portion of the lip, as well as strong sinuses, and its wide, folded columella with a tooth-like process and sunken middle area (vaguely resembling *intracallosus* but stronger). Its general shape may be compared with that of *buschi* (according to what Pilsbry figured in 1911, (pl. 61b, fig. 2), but it differs entirely in colors, columella and convexity of the whorls.

Compared with *P. conicus*, *P.f. concordianus* is shorter, more pyramidal and differ in color and columellar area. Pilsbry (1911, Non Marine Mollusca of Patagonia, Princeton Exped., pl. 38, fig. 4) figured some young *P. rushi* which resembles *concordianus* in shape but lacking its most prominent features: folds in columella, spiral bands, carina stronger and cordiform.

P. felipponei concordianus bears with typical *felipponei* the same relation of geographical variation found between *P. petitianus* and *P. petitianus sykesi*. Although the differences between the Montevideo type and the Concordia specimens are remarkable, they do not justify a new species name, but properly subordinate allopatrically as subspecies.

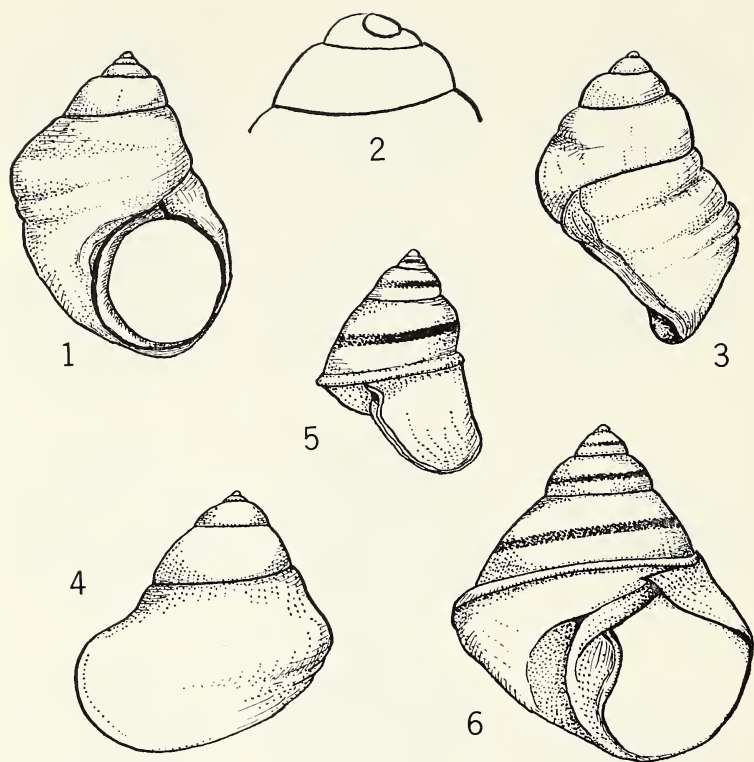
The two new subspecies are from a revisional study of the genus, published in 1965, Sterkiana no. 20: 26 & 36 (Research supported by grant NSF-15032).



Holotypes. A-C. *Mesodon clausus trossulus* Hubricht. D-F. *Glyphyalinia luticola* Hubricht. G-I. *Glyphyalinia pecki* Hubricht. J-L. *Helicodiscus hexodon* Hubricht. Photographs by Field Museum of Natural History.



Kalendyma vandervietii Clench. Fig 1, Holotype; Fig. 2, Paratype, both from Ataa, Malaita Id., Solomon Islands (both 3X).



Figs. 1-4. *Potamolithus peristomatus misionum* Parodiz (x 8), San Javier, Uruguay River, Misiones, Argentina. 5. *P. felipponei* Ihering (Montevideo; Cf. Pilsbry, op. cit.). *P. felipponei concordianus* Parodiz (x 17.5), Arroyo Yuqueri Grande, Entre Rios, Argentine.

ANATOMY OF THE SUCCINEID GASTROPOD *OXYLOMA SALLEANA* (PFEIFFER)

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Oxyloma salleana (Pfeiffer), family Succineidae, is a snail of the lower Mississippi River valley of the United States. Its known geographic distribution extends from New Orleans, Louisiana, as far north as Hardin, Jersey Co., Illinois, between 91° and 89° longitude, along either the Mississippi or the Illinois rivers. The localities from which this species has been taken include New Orleans, Louisiana; near Memphis, Shelby Co., and Samburg, Obion Co., Tennessee; Crève Coeur Lake, St. Louis Co., Missouri; Pittsburg Lake near East St. Louis, St. Clair Co., and Hill Lake near Columbia, Monroe Co., Illinois (Pilsbry, 1948, p. 792). I have found large populations of this species living on the banks of the Illinois river at Pere Marquette State Park, Jersey Co., and at Hardin, Jersey Co., Illinois, and along the Mississippi River in Southport, near New Orleans, Louisiana. Perhaps further collecting will reveal a wider geographic distribution of this species.

In Southport, Louisiana, the habitat of *Oxyloma salleana* is on the mudflats between the Mississippi River and the levees. I found the snails creeping on the ground, especially on willow leaves, and on moist decaying logs. At Pere Marquette State Park, Illinois, I took the snails from the shaded muddy banks of the Illinois River and from the leaves of *Sagittaria* sp. growing in the water. At Hardin, Illinois, I found most of the snails creeping on the very wet, muddy shore of the Illinois River where they were exposed to the direct sunlight; whereas some were near the shore in an area shaded chiefly by willow trees. The localities at Pere Marquette State Park and Hardin are flooded whenever the Illinois River reaches flood stage. I have found large populations of *O. salleana* in the summertime following a flooding of the area in the spring. This indicates that this species survives such flooding and becomes reestablished within the same season.

The Shell. The thin, glossy, amber-colored, elongate-ovate shell consists of $2\frac{3}{4}$ - $3\frac{1}{2}$ convex, sharply incised whorls. From the broadly arcuate base the shell becomes gradually inflated towards the upper third of the ultimate whorl from where it narrows to form a short, bluntly tapered spire. The large, elongate-ovate aperture, broadly

TABLE I
Measurements of Shells of *Oxyloma salleana* (Pfeiffer)

STATION	No. of Whorls	Height	Width	Width/Height	Height of Aperture	Width of Aperture	H. Ap./H. Shell	W. Ap./W. Shell	W. Ap./H. Ap.
Hardin, Illinois Illinois River June 11, 1964	3-1/2	19.0 mm.	12.4 mm.	.653	14.5 mm.	8.4 mm.	.763	.677	.579
	3-1/2	18.0	12.5	.695	14.6	8.2	.811	.656	.561
	3-1/4	17.6	12.2	.693	14.2	8.3	.806	.680	.585
	3-1/4	17.4	11.6	.667	13.3	8.2	.765	.707	.616
	3-1/2	17.3	11.4	.659	13.8	7.8	.798	.684	.565
	3-1/4	17.2	11.5	.668	14.0	8.2	.814	.713	.585
	3-1/4	17.1	10.8	.632	13.0	7.7	.760	.713	.592
	3-1/2	17.1	10.4	.608	13.0	7.4	.760	.712	.569
June 18, 1965	3-1/8	16.4	8.2	.500	12.5	7.1	.762	.865	.568
	3-1/4	16.0	8.0	.500	11.7	6.8	.731	.850	.581
	3-1/4	15.4	8.3	.532	12.6	6.8	.818	.819	.539
July 6, 1965	2-3/4	18.4	9.8	.532	15.0	8.0	.813	.816	.533
	3	18.2	9.3	.510	14.4	8.0	.791	.860	.555
	3-1/4	18.0	10.0	.555	14.0	7.5	.777	.750	.535
	3	18.0	10.0	.555	14.5	7.9	.805	.790	.544
	3-1/4	17.8	9.2	.516	13.5	7.6	.758	.826	.562
	3-1/4	17.5	10.0	.571	13.7	7.7	.782	.770	.562
	3-1/4	17.5	9.6	.548	13.4	7.6	.765	.790	.567
	3	17.3	9.0	.520	12.6	7.2	.728	.800	.571
	3	16.8	9.7	.577	13.6	7.7	.809	.793	.566
Pere Marquette State Park, Ill. Illinois River June 15, 1954	3-1/4	18.2	10.3	.565	14.5	8.5	.796	.825	.586
	3-1/4	18.1	10.2	.563	15.6	8.7	.861	.852	.557
	3-1/4	15.1	8.8	.582	13.2	7.3	.874	.829	.553
	2-3/4	15.0	9.2	.613	12.2	7.5	.813	.815	.614
Sep't. 15, 1958	3-1/4	16.4	9.5	.579	12.6	7.4	.768	.779	.587
	3-1/4	15.9	10.7	.673	12.1	7.3	.761	.682	.603
	2-7/8	14.6	9.7	.664	11.8	7.0	.808	.722	.593
	3-1/4	14.5	9.3	.641	11.5	6.7	.793	.720	.582
	2-7/8	13.4	8.5	.634	10.6	6.7	.791	.788	.632
	3	12.2	7.9	.648	9.0	5.7	.738	.722	.633
Sep't. 29, 1963	3-1/4	16.1	9.0	.559	11.7	6.7	.726	.744	.572
	3-1/4	15.5	8.2	.529	11.2	6.6	.722	.804	.589
	3-1/4	14.7	8.5	.578	11.5	6.5	.782	.764	.565
	3-1/8	14.7	8.2	.557	10.9	6.5	.741	.792	.596
June 11, 1964	3	15.1	8.0	.529	11.8	6.6	.781	.825	.559
	2-3/4	15.0	8.0	.533	11.4	6.4	.760	.800	.561
	2-7/8	14.2	8.7	.612	11.2	6.8	.788	.781	.607
Southport, New Orleans, La. July 22, 1964	3	15.7	8.6	.547	12.5	7.5	.796	.872	.600
	2-3/4	15.3	8.3	.542	12.1	7.2	.790	.867	.595
	3	15.0	7.5	.500	11.8	6.8	.786	.906	.576
	2-3/4	14.5	7.5	.517	11.4	6.4	.786	.853	.561
	2-1/2	13.6	7.0	.514	11.1	6.7	.816	.957	.603
	2-3/4	13.0	7.3	.561	9.8	6.0	.753	.821	.612

Table I. The measurements of the largest shells of each of the 3 stations obtained in the season and year as noted. In the 4th column of measurements are listed the ratios of the width of the shell over its height. In the last 3 columns are listed the ratios of the height of the aperture over the height of the shell; width of aperture over width of shell; width of aperture over height of aperture.

arcuate at its base, becomes sharply attenuated toward the spire; its height ranges from 73% to 81.8% of the total height of the shell as is shown in Table I. The sharp peristome becomes roundly infolded along the inner border of the ultimate whorl and is continuous with the columella. In some shells the columella emerges below the apex of the aperture and continues along the ultimate whorl in the form of a thin, white, spiral plait such as that occurring also in *Oxyloma retusa* (Lea) (Franzen, 1963, p. 86) and in *Oxyloma haydeni* (W. G. Binney) (Franzen, 1964, p. 75). Frequently a thin callous forms on the portion of the ultimate whorl bordering the aperture.

The nuclear whorl is finely punctate and marked with fine, evenly-spaced striae on its lower half. The penultimate whorl is marked with fine, closely-spaced ridges and furrows. The striae become coarser, the irregularly spaced ridges heavier and the furrows deeper and wider, producing a rough surface on the ultimate whorl.

The range in height and width of the shell, ratios of these two dimensions, the size of the aperture, and ratios of the height to the width of the aperture, as well as ratios of the dimensions of the aperture to corresponding shell dimensions, are to be noted in Table I. The measurements of the shells are those of the largest taken from the 3 stations and during the time of seasons as noted. Because *O. salleana* is essentially southern in its geographic range, one might assume that the largest shells would be found in the southern-most localities. Pilsbry (1948, p. 792) reports shells taken from New Orleans measuring up to 19.3 mm. in height. However, he does not indicate the date of collection. The shells which I obtained from Southport, near New Orleans, were collected in the latter part of the month of July. As is noted in Table I, these shells are shorter than the measurements reported by Pilsbry as well as those which I obtained from the two localities in Illinois. The dates of collection of the largest shells from the Illinois stations were in the months of June and July. This may mean that in the southern localities the older snails surviving from the previous summer die earlier in the following summer than is true of snails in more northern localities, and that the shells I obtained from Southport, Louisiana, did not represent maximum size attained.

The significant characteristics which distinguish the shell of *Oxytoma salleana* from that of *O. retusa* are those of certain dimensions. This becomes obvious when the shells of the two species are observed simultaneously and which, also, is illustrated in figure 1. The shell of *O. salleana* is not so streamlined as that of *O. retusa*. The median of the ratios of the width to the height of the shell of *O. salleana*, of those whose measurements are included in Table I, is .563, whereas of *O. retusa* the median of the series of the shells measured is .520 (Franzen, 1963, Table I). The difference in ratios of the height of the aperture to the height of the shell is also to be noted. Of *O. salleana* the median of such a ratio is .786 and of *O. retusa* .744. The ultimate whorl of *O. salleana* is more inflated and the spire shorter than in *O. retusa*.

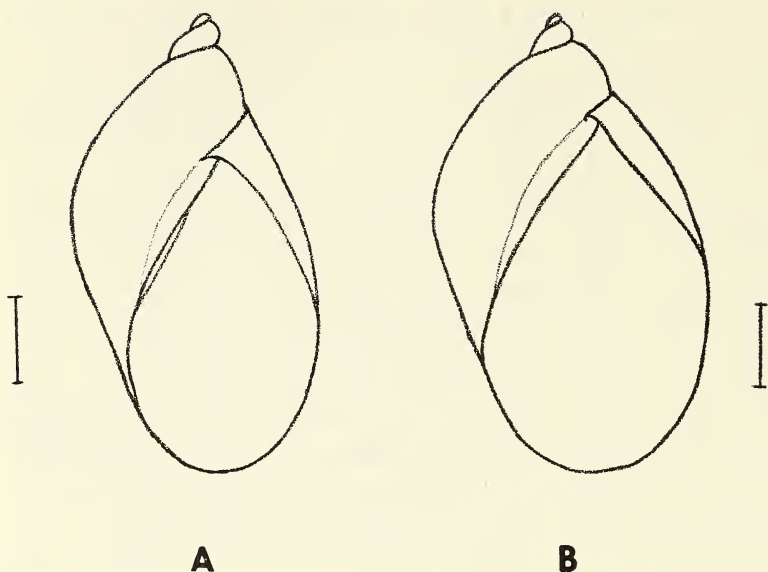


Figure 1. A. Shell of *Oxytoma retusa* (Lea) from White Cloud, Kansas. Scale line represents 17.3 mm., actual height of shell. B. Shell of *Oxytoma salleana* (Pfeiffer) from Hardin, Illinois. Scale line represents 17.5 mm., actual height of shell.

Pfeiffer describes the shell as being composed of $2\frac{1}{2}$ whorls (Pfeiffer, 1849, p. 133). Pilsbry (1948, p. 792) considers that the smaller number of whorls ($2\frac{1}{2}$) distinguishes this species from *O. retusa* (Lea). However, I did not find that to be true as noted when comparing the figures of *O. salleana* given in Table I with those of *O. retusa* (Lea) (Franzen, 1963, Table I).

Description of the Body Wall and Mantle. The body wall is cream colored, finely and irregularly tuberculated. The pigmentation of the dorsal, anterior portion of the head consists of black flecks arranged in four pairs of longitudinal bands, of which three pairs terminate at the base of the posterior tentacles. The fourth band of either side courses lateral to the tentacles uninterrupted to the level of the mantle collar. The two median bands converge at the level of the posterior tentacles to form a single band occupying the area between the posterior tentacles and continuing caudad to the level of the mantle collar; this band may bifurcate as it progresses caudad. Posterior to the tentacles this median band is flanked on either side by a band extending from the tentacles to

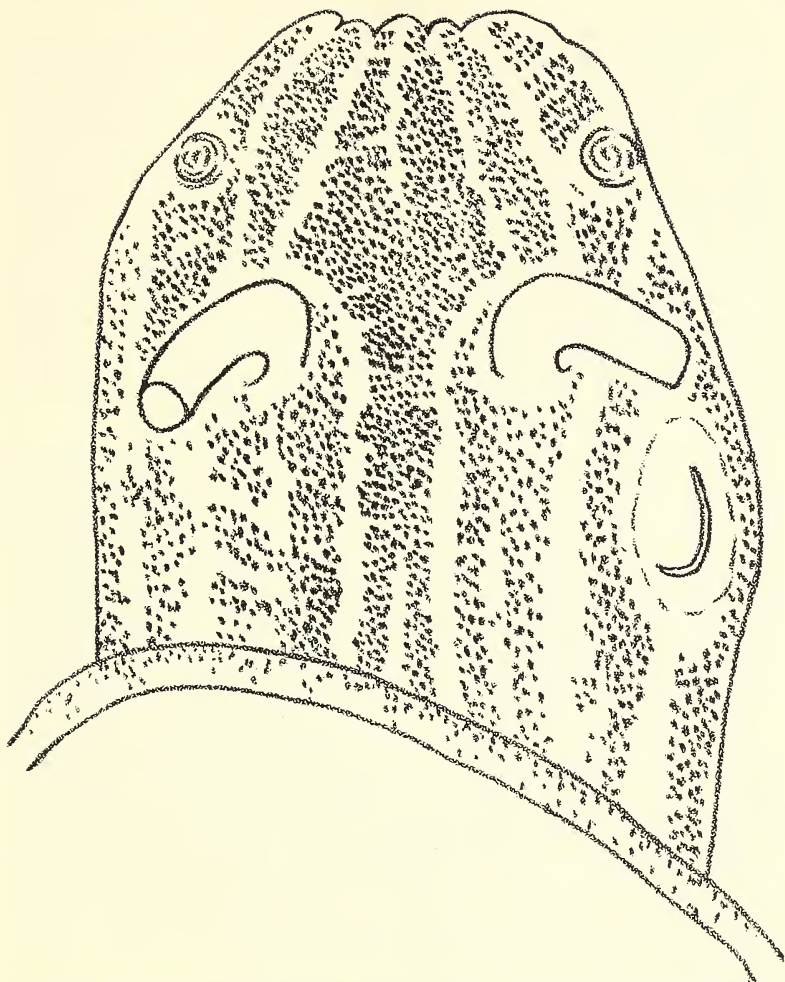


Figure 2. Drawing of head of *Oxytoma salleana* (Pfeiffer) showing pattern of pigmentation.

the mantle collar. The lateral body wall is covered with a broad band of blotches of pigment, figure 2. The degree of the intensity of this pigmentation as well as the distinctiveness of the bands is an individual variant. Of the bands on the anterior head region, the third band, which crosses over the anterior tentacles, may be quite distinct or it may be fused with the fourth band. Likewise, the fourth band may be fused with the broad band of the lateral body wall.

The mantle collar may be lightly or heavily pigmented. The pigmentation of the mantle is, likewise, variable. The entire surface may be darkly and uniformly, or it may be lightly, pigmented. The anterior portion may be heavily pigmented or the pigmentation may be in the form of irregular bands, while the posterior portion of the mantle is covered with blotches of pigment. Or the pigmentation may take the form of blotches over the entire mantle surface. through the mantle the kidney is to be seen, unless obscured by heavy pigmentation of the mantle, as a yellow band following the contour of the body. The distinct dark pigment band characteristically outlining the posterior margin of the kidney in *O. retusa* and *O. haydeni* is lacking in *O. salleana*. Or if such a band is present, it is not so pronounced.

A pedal groove, continuous from the labial palp on one side of the animal to the palp of the other side, separate the foot from the lateral body wall. A less pronounced suprapedal groove parallels the pedal groove dorsally. Shallow, vertical grooves incise the pedal and suprapedal grooves and the broad band of pigment. These vertical grooves produce a series of shallow scallops along the ventral margin, especially when the animal is in a partially contracted state. The sole of the foot may be unpigmented or it may be flecked.

The genital aperture, located on the right-hand side of the body wall, surrounded by a white tumid lip, may appear as an irregularly elongate or a crescent-shaped slit, 0.5 mm. to 0.8 mm. in length, depending upon its state of contraction. The shape and size of the genital aperture, as well as that of the lip, is comparable to that of other species of *Oxyloma* studied by the author, namely *O. retusa* (Lea) (Franzen, 1963) and *O. haydeni* (W. G. Binney) (Franzen, 1964).

The Radula. The structure of the radula of *Oxyloma salleana* bears the general generic characteristics. In the radulae studied, the total number of rows of teeth range from 80 to 100. The number of teeth in a row, as well as the number of laterals and marginals, varies. In the rows, excepting those of the most anterior portion of the radula, the ratio of the marginals to laterals approaches 1:3 or 1:4 as can be noted in table II. This is similar to what has been reported of *O. retusa* (Franzen, 1963, Table II) and of *O. haydeni* (Franzen, 1964, table II). The form of the teeth is also characteristic of the genus. The basal plate is longer and more tapering than

TABLE II

Station	No. of Rows of Teeth	No. of Teeth in a Row	Tooth Formula
Southport, New Orleans, La.	(a) 94	52	13 - 11 - C - 9 - 18
		91	37 - 8 - C - 9 - 36
	(b) 126	93	34 - 12 - C - 12 - 34
		94	34 - 12 - C - 12 - 35
Hardin, Ill.	(a) 91	91	23 - 10 - C - 16 - 31
	(b) 98	102	42 - 10 - C - 12 - 37
		102	42 - 10 - C - 12 - 37
		90	43 - 9 - C - 11 - 26
	(c) 100	108	42 - 11 - C - 12 - 42

Counts made of representative radulae to show variations in the number of rows of teeth in a radula and variations of the number of teeth in a row.

that of *Succinea* and *Catinella* (Quick, 1933, p. 296, figs. 1-4; Franzen, 1959, fig. 3).

The central tooth has the structural characteristics of the succineids, namely, a large mesocone flanked on either side by a smaller ectocone. The laterals have a large mesocone and a smaller ectocone. Occasionally laterals located near the marginals have also an endocone. The marginals have an endocone, a mesocone, and an ectocone. The ectocone of the most medial marginals is divided into two cusps of which the lateral one is characteristically longer and heavier than the other. The remaining marginals have an ectocone which is divided into three cusps. The lateral cusp is longer and usually heavier than the other two. Infrequently the cusps of the ectocone are of equal size.

The Jaw. The amber-colored jaw resembles that of *Oxyloma retusa*. It has a large median fold which projects anteriorly. In several jaws which I have studied, a lateral fold flanks the median fold as is also characteristic of *O. retusa* (Franzen, 1963, Fig 2). Likewise, the jaw lacks the series of small lateral folds characteristic of the jaw of *Succinea ovalis* Say (Franzen, 1959, Fig. 2). No distinctive specific features of the jaw were noted.

The Reproductive System. The penis and the vagina are located in the right anterior region of the animal. The penis is located to the left of the vagina. The elongate penis is encased in a sheath which is slightly pigmented with black flecks over the distal $\frac{2}{3}$ of its surface.

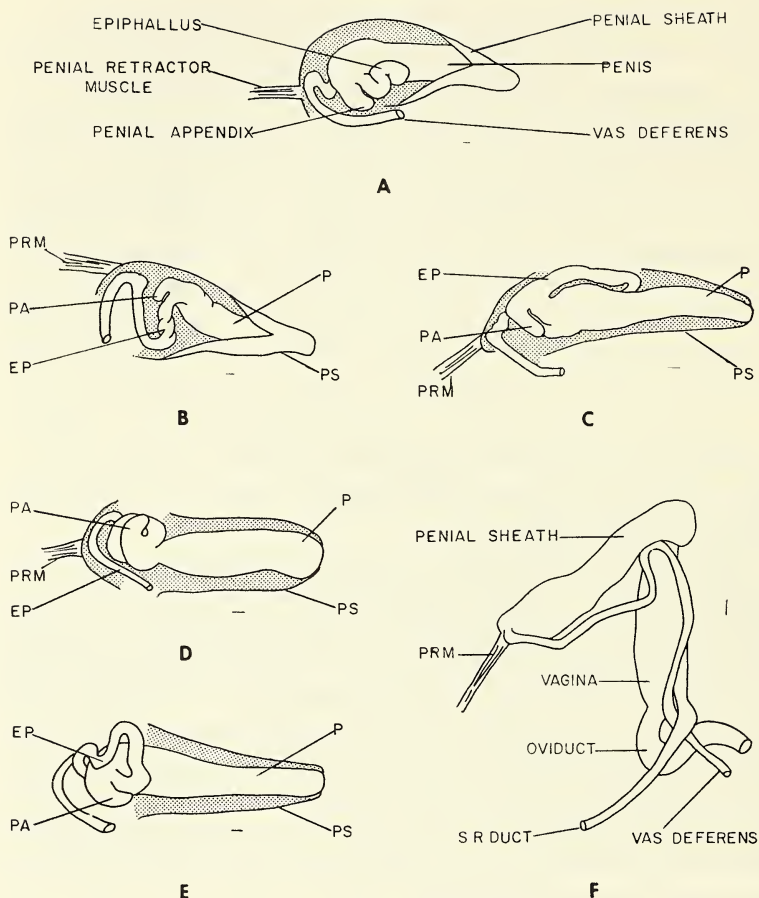


Figure 3. A - E: Penis shown inside of penial sheath cut open. All figures are from snails taken from the station at Hardin, Illinois. The scale lines represent the following measurements from epiphallus to end of penis: A. 3.6 mm.; B. 3.2 mm.; C. 4.8 mm.; D. 4.2 mm.; E. 4.8 mm. F. Drawing showing relative position and lengths of penial sheath and vagina. Scale line of entire length of drawing, 60 mm.

The epiphallus (the vas deferens after its entry into the sheath) is coiled and recurved around the penis in no regular fashion. It enters the penis subterminally as shown in A - E of figure 3. Pilsbry (1948, p. 793) describes the epiphallus as being nearly straight. This is not true of the individuals of *O. salleana* which I have dissected including those from New Orleans as well as those from the

two localities in Illinois. The penial appendix is inflated, its diameter tends to be uniform in its entire length, and its end is bluntly rounded. I have not found any penial appendix to be digitiform as is characteristic of *O. retusa* and of *O. haydeni* nor to have its terminus in the form of a blunt hook as is found in *O. haydeni* (Franzen, 1964, Fig. 1). The length of the vagina approximates that of the penial sheath. The oviduct and the duct from the seminal receptacle enter the vagina terminally as shown in Figure III, F.

The length of the prostate gland generally equals that of the albumin gland. In *O. retusa* and in *O. haydeni* I have found the prostate gland to be consistently shorter than the albumin gland. The acini of the prostate gland are about twice the size of those of the albumin gland. The seminal vesicle is a bilobed structure; the two lobes are equal to subequal in length. The amount of pigmentation of the lobes is variable, which is true also of the hermaphroditic duct. Both of these glandular organs are enclosed in a thin transparent sheath on which may be scattered flecks of black pigment.

Chromosomes. The search for reliable criteria in the identification of species of succineids has led to the investigation of the possibility of the employment of the specific numbers of chromosomes along with anatomical characteristics. For such purposes sperm cells in segments of ovotestis fixed in Newcomer's fixative, stained with acetic-orcein and squashed between a glass slide and a cover slip, have been studied.

Examinations which have been made of *Oxyloma salleana*, *O. retusa* and *O. haydeni* reveal that the haploid number of chromosomes of these species is nineteen. The snails used for such studies were obtained from several geographically separated localities. My studies were of snails of *O. salleana* from the Hardin, Illinois, station, of *O. retusa* from White Cloud, Doniphan Co., Kansas, and from Meade County State Park, Kansas, and of *O. haydeni* from a station twenty-one miles south of Valentine, Nebraska. The study of *O. salleana* obtained from Southport, Jefferson Parish, Louisiana, has been reported (Natarajan, Hubricht, Burch. In press). J. B. Burch (personal communication) examined tissues of *O. retusa* obtained from White Cloud, Doniphan Co., Kansas.

Chromosome numbers do not always distinguish one species from

another. Continued studies may reveal that certain groups of species share common numbers which may prove to be of some taxonomic value.

SUMMARY

Shells of succineids generally lack sharply defined specific features. However, certain characters such as the ratios of the height of the aperture to the height of the shell and the width of the shell to its height are useful in distinguishing *Oxyloma salleana* from *O. retusa*.

Anatomical features which distinguish *O. salleana* from *O. retusa*: 1. Penial appendix. The penial appendix of *O. retusa* is generally a distinctly digitiform structure although variable in length. The penial appendix of *O. salleana* is inflated; its diameter tends to be uniform in its entire length and its end is bluntly rounded. I have not found variations comparable to those occurring in *O. retusa* (Franzen, 1963). 2. Relative size of the albumin gland to the prostate gland. In *O. retusa* I have found the prostate gland to be consistently smaller than the albumin gland (Franzen, 1963). The dissections I have made of the snails from the three stations noted reveal that in *O. salleana* the length of the prostate gland tends to equal that of the albumin gland. 3. Pigmentation of the body. The pattern of pigmentation of the head region of *Oxyloma salleana* is more consistently in the form of bands (as shown in Figure II) than is characteristic of either *O. retusa* or of *O. haydeni*. The pigmentation along the lateral body wall assumes the form of a broad band as it does in *O. retusa* but which is not characteristic of *O. haydeni*. If the darkly pigmented band on the mantle outlining the posterior margin of the kidney is present, it is not as distinct as in *O. retusa*.

Geographic distribution and habitats. *Oxyloma salleana* is a species of the lower Mississippi River valley whereas *O. retusa* is found in the upper Mississippi River valley. Both species live on muddy to wet ground and on vegetation growing in water. *O. retusa* favors cattails (*Typha* sp.) and reeds, whereas I have found *O. salleana* to favor *Sagittaria* sp.

Acknowledgments. This study has been made possible through the financial assistance of a National Science Foundation Grant-in-Aid. Henry van der Schalie kindly made available to me facilities of the Div. of Mollusca, Mus. of Zoology, Univ. of Michigan, for the study of chromosomes of succineids, and also offered helpful

suggestions. I am grateful to J. B. Burch and R. Natarajan for assistance and suggestions offered in my study of chromosomes.

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NOTES AND NEWS

EDWIN PERRIN BAKER: Oct. 15, 1891 - April 24, 1966. — We have suffered a loss in the passing of a dear friend, a native Californian, born in Poway, San Diego County. He entered high school at Pasadena, but soon thereafter registered in the Training School for Christian Workers, an interdenominational school run by Quakers. There he finished high school and more than two years of Bible study. In 1913 he registered at Nazarene University, Pasadena with sufficient Bible credits to enable him to graduate with one year's additional work. He earned the degree of Bachelor of Theology. He wished to continue in art work; however, his mother wished him to enter the ministry. As there was no opening in ministerial work at the time, he became employed in a sign shop doing lettering and illustrating.

He married Irene Donaldson in 1937. Through their interest in the work of the American Friends Service Committee they travelled extensively among the Indians of the southwest. They visited various reservations of California, Arizona, and New Mexico. Shells always travelled with them and were distributed among the Indians.

Mr. and Mrs. Baker became avid shell collectors. Mr. Baker

served as president of the Conchological Club of Southern California. He was also president of the Long Beach Shell Club, and later chairman of the American Malacological Union Pacific Division. The Baker natural history collection and library is left to the family.

Mr. Baker is survived by his widow, Irene Baker, two daughters, Mrs. Edith Repogle and Miss Edna Perrin Baker, five grandchildren, several great-grandchildren, and a host of friends. —Mrs. John Q. Burch, 4206 Halldale Ave., Los Angeles, California 90062.

EXTENSION IN RANGE FOR *DOSINIA DISCUS*. — On a recent trip to Sanibel-Captiva Islands I found 3 specimens of *D. discus* (Reeve) near the northern end of Captiva Island. At the time this genus was monographed in *Johnsonia* (1942, no. 3, pp. 1-5) we had seen no specimens south of Tampa Bay.

In the second edition of "Marine Shells of the Western Coast of Florida" (1955), Perry and Schwengel state that "*Dosinia discus* (Reeve) is occasionally found north of Tampa and may be distinguished from *D. elegans* by its finer and closer concentric striation and its more compressed form."

The west coast of Florida from Cedar Keys to Naples is perhaps the most thoroughly collected area of the Atlantic coast of the United States. It seems reasonable to assume that *D. discus* would have been found in our large museum collections from the area south of Tampa Bay had it occurred there prior to 1955. *Dosinia discus* and *D. elegans* are sympatric species since they occur together in many sections of their ranges from Cape Hatteras to Northern Yucatan. Competition on any large scale between the two species is apparently of no great importance and any minor temperature change could hardly be effective, as this area is in the approximate center of their ranges. Just what has occasioned this range extension is at present unknown. It will be of considerable interest to see if *D. discus* is found elsewhere south of the Tampa Bay area. — W. J. CLENCH.

CYPRAEA (PROPUSTULARIA) SURINAMENSIS Perry from Brazil. — Mr. Henry R. Matthews of Fortaleza, Ceará, Brazil, kindly has informed us (*in lit.*) that he has found in recent months 12, well-preserved specimens of this rare cowrie. They were taken from the digestive tracts of a bottom-dwelling toadfish, *Amphichthys crypto-*

centrus, caught off Fortaleza in depths of approximately 15 fathoms. Inasmuch as "Surinam" (Dutch Guiana) was the most southern locality previously reported, the Brazilian specimens extend the range southward below the equator to about 4° S. latitude.

According to Mr. Matthews, measurements of nine of the shells range in length from 28 to 35 mm., with an average of 31.08 mm. and a median of 31 mm.; width ranges from 18 to 22 mm., with an average of 20.33 mm. and a median of 20 mm.; height ranges from 13 to 19 mm., with an average of 15.66 mm. and a median of 16 mm. All but two of the twelve specimens have the "inflated form" as described in our recent paper (Nautilus, 1965, 79(1):27, pl. 3, fig. 2). — WILLIAM K. EMERSON and WILLIAM E. OLD, JR., The American Museum of Natural History, New York City.

ON AMPULLINA GUPPY. — In a paper in the Proc. Victoria Inst. Trinidad (1895, pp. 72-77) referred to by H. B. Baker (1927, Nautilus 41:22), Guppy cited *Ampullina* in the subgenus *Helicina* (p. 74) and listed 3 species under this taxon: *H. moquiniana* Pf., Fiji; *H. amoena* Pf., Guatemala; and *H. concentrica* Pf., Venezuela.

The name *Ampullina* DeBlainville, 1824, Dictionnaire Sciences Naturelles 32:235 (type species, *Ampullina striata* DeBlainville, monotypic); 1825, Manuel de Malacologie, p. 441 [as *Ampulline*] is now in the synonymy of *Viana* H. & A. Adams because of an earlier use by Bowditch (1822, Elements of Conchology (Paris), p. 31, pl. 9, fig. 2) for a naticid.

In order to prevent *Ampullina* Guppy (*non* Bowditch 1822; DeBlainville 1824; Fischer 1885) from being confused with the synonyms of *Viana*, we hereby designate as type species *Helicina amoena* Pfeiffer (1848, Proc. Zoo. Soc. London, p. 119) and thus make *Ampullina* Guppy a synonym of *Oxyrhombus* Crosse & Fischer, 1893, same type by subsequent designation of H. B. Baker (1922, Proc. Acad. Nat. Sci. Philadelphia 74:48). — W. J. CLENCH and M. K. JACOBSON.

LEHMANNIA IN MASSACHUSETTS. — In May and June, 1966, a considerable number of specimens of *Lehmannia poirieri* (Mabille) were collected in the Boston area. This appears to be the first record of the slug in New England. In the greenhouses of the Mt. Auburn Cemetery, Watertown, Middlesex County, over 50 slugs were found in a few minutes, including one melanic speci-

men. Three individuals were collected in the greenhouse of the Pine Grove Cemetery in Lynn, Essex County. The slug seems to be restricted to greenhouses at the present, but probably in time will spread into neighboring gardens and other areas. — LANDON T. Ross, Dept. of Geology, Harvard University, Cambridge, Mass.

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ON THE TAXONOMY AND BIOLOGY OF THE DORID NUDIBRANCH DORIDELLA OBSCURA

By DAVID R. FRANZ

Dept. Zoology, Univ. of Conn., Storrs

In 1963, the writer discovered a large population of *Doridella obscura* Verrill in lower Delaware Bay, a population also noted by Lowden (1965). These animals occur both in deep water (20-25 ft., oyster beds) and in the intertidal zone, wherever substrate and food conditions permit survival. In reviewing the available literature, it soon became apparent that little information exists on the biology of this animal. Moreover, the taxonomic status of *Doridella* has been in doubt for many years, principally because the original description (Verrill, 1870) was inadequate and subsequent authors have failed to search for and compare Verrill's type material. In this report, I have reviewed briefly the taxonomy of *Doridella* and added a few observations on its biology in Delaware Bay.

Doridella obscura was described by Verrill on the basis of a single specimen collected at Savin Rock, Connecticut. In later years (Verrill, 1880) collections were made from Block Island Sound, Vineyard Sound and Great Egg Harbor, N. J., and Verrill noted (1873) that it occurred both along the rocky shores of bays and sounds and in oyster beds in brackish water.

Doridella has been placed in the family Corambidae of Bergh, 1869, (family Hypobranchiaidae of authors: Fischer, 1887; MacFarland and O'Donoghue, 1929; Harry, 1953). The status of Hypobranchiaidae has been discussed by Marcus (1960). The type genus of Corambidae is *Corambe* Bergh, 1869, with *Corambe sargassicola* Bergh (1872) as its type species. The genus is characterized by the presence of a notch in the posterior margin of the notum on the midline. This notch is not present in *Doridella* according to Verrill (1870). In 1899, Balch erected the genus *Corambella* with the type species *C. depressa* Balch from Cold Spring Harbor, Long Island. As noted by Marcus (1955), *Corambella* differs from *Corambe* only by the absence of a posterior notch

in the notum. Apparently, Balch felt justified in ignoring Verrill's genus *Doridella* on the grounds that Verrill's later descriptions (1873, pp. 401, 664) are contradictory regarding the location of the branchiae. In 1953, a second species of *Corambella* was described, *C. baratariae* Harry from Louisiana.

The proper generic allocation of all described species of "un-notched" corambids requires a re-analysis of the systematic position of *Doridella* Verrill, 1870.

I have examined the holotype of *D. obscura* (Yale Peabody Mus. No. 13273). Unfortunately, this specimen is completely desiccated and useless for determination of external morphology. However, two lots of two specimens each, collected and identified by Verrill from Outer Island and Thimble Island, Branford, Conn. (YPM No. 13179, 10/21/1893) and Savin Rock (YPM No. 13180, 11/5/1874), were examined. In addition, a lot of 3 specimens collected by W. R. Coe from New Haven was examined (YPM No. 13178). The length and width measurements of Verrill's collections from Branford were 1.98x1.73 and 1.54x1.09 mm. respectively. The animals from Savin Rock measured 1.92x1.47 and 1.60x1.44 mm. The 3 specimens from New Haven were 3.80x3.13, 1.99x1.80 and 3.13x2.75 mm respectively.

Evidently, the type material of *Corambella depressa* Balch is lost. However, I have examined paratypes of *C. baratariae* Harry (USNM No. 597689, F-766 - slide) along with preserved material from North Carolina and Virginia and both living and preserved material from New Jersey. *Doridella* does not have a posterior notch in its notum and corresponds in its external appearance in all respects to the paratypes of *Corambella baratariae*. Therefore, *C. baratariae* Harry (1953) must be considered a synonym of *Doridella obscura* Verrill (1870). The specific differences between *C. depressa* and *C. baratariae* as listed by Harry (p. 4) are, in my opinion, insignificant. The position of the genital complex on the left side as reported by Balch for *C. depressa* is almost certainly an error in observation. No known nudibranchs exhibit this phenomenon. The reticulate pattern of the notum in *C. depressa* disappears in preserved material and the pattern of pigment spots is extremely variable. Moreover, Balch himself, due to the preservation of the animals, expresses some doubt concerning his original description of the rhinophores and sheaths and also

concerning the presence of armature in the penis. The grooves on the ventral surface of the head described by Harry for *C. baratariae* are invisible in many preserved animals without staining. The buccal armature noted in *C. baratariae* is not generally evident in unsectioned material. The radula, as figured by Balch, does not appear to be significantly different from *C. baratariae* if cognizance is taken of the variability in appearance of radulate depending on the way in which they have been mounted. Thus, the available evidence strongly suggests that *C. depressa* Balch and *C. baratariae* Harry are conspecific. In this case, as noted above, both are synonyms of *Doridella obscura*.

D. obscura was recorded by Verrill (1880) from locations ranging from Vineyard Sound, Mass., south to Great Egg Harbor, N. J. The type locality of *C. depressa*, as with *D. obscura*, is in Long Island Sound. Nudibranchs identified as *C. baratariae* have been collected from Raritan Bay, N. J. (Dean, D., 1957, unpubl.) south to Virginia, North Carolina (Marcus, 1961) and on the Gulf Coast from Mississippi (Moore, D., 1961), Louisiana and Texas (Marcus, 1960). This distribution, which encompasses almost the entire eastern seaboard of the U. S., indirectly supports the contention that we are dealing with a single, widely distributed species.

The present status of *Doridella* and its contained species may be summarized as follows:

Genus *Doridella* Verrill

Doridella Verrill, 1870, Amer. Journ. Sci. and Arts, L (CL): Art. XLVI, p. 405.

Corambella Balch, 1899, Proc. Bost. Soc. Nat. Hist. 27 (7): 151.

DORIDELLA OBSCURA Verrill

Doridella obscura Verrill 1870

Corambella depressa Balch 1899

Corambe obscura Sumner et al., 1913, Bull. U. S. Bur. Fish. 31 (Pt. 2): 705.

Corambella baratariae Harry 1953. Occas. Papers Mar. Lab., La. State Univ., Baton Rouge. No. 8, p. 1.

DORIDELLA CARAMBOLA (Marcus)

Corambella carambola Marcus 1955, Zoologia 20, Bol. No. 207, p. 89.

DORIDELLA STEINBERGAE (Lance)

Corambella steinbergae Lance 1962, The Veliger 5 (1): 33.

Size and External Appearance of N. J. Doridella: The largest living specimen collected was 7.50x3.41 mm. but in general, they range from 2 - 4 mm. in length. A representative series of 20 preserved specimens ranged in size as follows:

Length	1.11 - 4.07 mm. with a mean of $2.99 \pm .17$ mm.
Width	1.19 - 3.73 mm. with a mean of $2.69 \pm .14$ mm.
Head Width	0.34 - 1.33 mm. with a mean of $0.87 \pm .06$ mm.
Foot Length	0.66 - 2.66 mm. with a mean of $2.02 \pm .14$ mm.
Foot Width	0.58 - 2.90 mm. with a mean of $0.58 \pm .12$ mm.

The dorsal coloration and pattern in this species is the result of a combination of two types of dendritic pigment cells in addition to a reticulated color network within the notum. Most animals have a variable number of black dendritic pigment cells which are located deep within the notum at or close to its ventral surface. In many specimens, especially some of those collected late in the season or collected from the laboratory sea water system, the black pigment cells are very small and few in number and, because of their depth in the notum, their effect on the overall coloration of the animal is minimal. Other animals have extremely large black pigment cells. In these, the pigment masses seem to fill up more of the space in the notum and in very dark animals, the black cells are extremely large, moving out into the normally unpigmented marginal area of the notum.

A second type of pigment cell is present in most animals. These are brown, located superficially in the notum, and rarely attain the size of the largest black cells. Following fixation, the brown cells may become very faint or disappear altogether. Very few animals have been observed which totally lack pigment cells of either type.

The reticulate pattern which can be seen in virtually all living animals appears yellow with reflected light but black in transmitted light. This would suggest that it is due to the presence of some opaque material, perhaps leucocytes, located either in blood spaces or some other network within the notum. A similar notal network has been reported in all corambids which have been observed alive and is particularly well illustrated in Lance's photographic figure of *D. steinbergae* (Lance, 1962).

Water Circulation: Although the animal can hold the margin of its notum tightly against the substrate, this structure is nor-

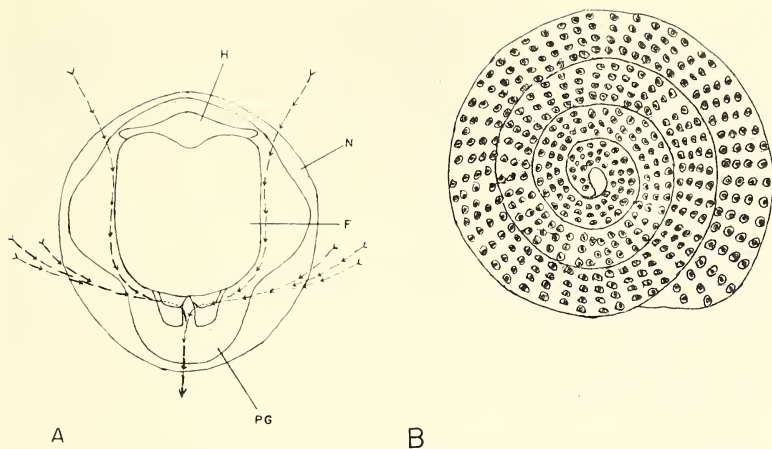


Figure 1. *Doridella obscura* Verrill. A. Ventral view showing path of ciliary respiratory currents. (x28). B. Egg mass (x34).

mally held in such a position that gaps occur between the substrate and the edge of the notum. A posterior gap, just behind the branchiae (Fig. 1a), is the functional analog of the notch in *Corambe*. However, the skirt of the notum can be manipulated so that a gap can occur anywhere along the margin. Water currents created by cilia on the dorsal surface of the foot and on the branchiae are drawn through gaps between the notum and substrate in front and on each side of the animal. This current is carried along the channel formed between the dorsal side of the foot and the ventral surface of the notum. The current is drawn over the surface of the branchiae and expelled as a single stream through the posterior gap. The various pathways followed by the respiratory currents are indicated in Fig. 1a. Carmine particles drawn under the notum are subjected to considerable mucous secretion and are generally heavily clumped when expelled through the posterior gap.

Feeding: In Delaware Bay, *Doridella* is always found in association with and feeding on incrusting Bryozoa. During most of the 1965 season, these nudibranchs were very common in the intertidal zone on shells incrustated with *Membranipora crustulenta* (Pallas). This species appeared to die out by October and during the autumn, the nudibranchs were observed to occur on *Alcyonidium verrilli* Osburn. In October, two specimens were found in deep

water on a bottle covered with *Acanthodesia tenuis* (Desor).

Oviposition: The egg mass, or at least part of one, was described by Verrill (1870). In New Jersey, egg production begins no later than June and continues until cold weather. The eggs are oval and are embedded in a transparent gelatinous matrix deposited on a flat surface in the form of a low, flat spiral (Fig. 1b). Very fine silt particles usually adhere to its surface making it virtually invisible. In a mass 2.66x2.37 mm., there are approximately 375 eggs, each averaging 0.11 mm. in length. Gravid nudibranchs have been observed to produce eggs at 5° C. and animals brought into the laboratory in November, 1965 produced egg masses at 10° C. The writer has kept unfed specimens over the winter in the laboratory at 10°.

I gladly acknowledge the aid of Dr. Joseph Rosewater who provided me with the paratypes of *C. baratariae* from the USNM and of Dr. Willard Hartman of the Peabody Museum at Yale University for his kindness in allowing me to examine Verrill's collections of *Doridella obscura*. I am also indebted to Dr. Ruth Turner of the MCZ who searched for the type of *C. depressa* and to C. J. Risso-Dominguez of Buenos Aires who provided many valuable suggestions. Finally, I appreciate the efforts of Dr. Robertson of the ANSP who critically reviewed this paper.

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SOME OBSERVATIONS ON THE ECOLOGY OF *Callocardia texasiana*

By PAUL S. BOYER

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Dead shells of the venerid clam *Callocardia texasiana* (Dall) occur uncommonly on Gulf Coast beaches from northwest Florida to Texas and Mexico. A few paired valves of recently deceased specimens have been found on Texas beaches, and one live adult individual has been taken from an unknown locality in the Gulf of Campeche by a commercial shrimp fisherman. Dr. T. E. Pulley (personal conversation) reports that William C. Guest collected live specimens in Matagorda Bay in 1956; this was following a period of drought which caused bay salinities to be abnormally high (Gunter, personal communication to Harry S. Ladd; cited in Ladd, 1951, p. 134). Abbott (1954, p. 416) has stated that the biology and habits of *Callocardia texasiana* are unknown.

While engaged in the study of the distribution of larger inverte-

brates with respect to various environmental parameters, the author recently made two trips by shrimpboat along the Louisiana Coast. On both trips, numbers of live *Callocardia texasiana* were collected by means of a small biological dredge. The following stations yielded living specimens:

LIP 10/12-10	8½ nautical miles south of Big Constance Bayou.
LIP 6/6-2	10 nautical miles south of Tigre Point.
LIP 6/6-3	9 nautical miles south of Tigre Point.
LPP 10/8-9	7 nautical miles south of Grand Bayou Pass.
LPP 6/9-5	7 nautical miles north of West Jetty, Southwest Pass.

At all locations where live material was found, the substrate consisted of a superficial layer (about 1 cm.) of flocculate clay material on 3 to 5 cm. of silty sand, overlying a stiff, gray mud. When collected, the live clams were coated with mud, in which they apparently had been living. Since the dredge could not have excavated deeper than about 8 cm. into the sediment, I estimated that the specimens collected must have been living about 4 to 8 cm. beneath the sediment surface.

Live clams were found at depths of from 24 feet (near the Mississippi Delta) to 80 feet (south-southeast of Marsh Island). Bottom salinities ranged from 28 (near the Delta) to 34 0/00 farther west; clearly, this species favors euhaline conditons.

According to data kindly supplied by the Bureau of Commercial Fisheries in Galveston, and supplemented by our own measurements, the bottom temperature ranges at the *Callocardia texasiana* stations are: for the winter, 63 to 67 F.; and for the summer, 79 to 86 F.

Although our Winkler measurements of bottom-water dissolved oxygen varied greatly along the Louisiana Coast, in 4 of the 5 stations at which live *Callocardia* were collected, the dissolved oxygen fell in a range of 5.7 to 6.0 ml/liter. The exception was the point nearest the Delta (LPP 6/9-5), which showed a dissolved oxygen content of about 2.8 ml/liter. The low oxygen content of bottom water at this station is a result of strong salinity-density stratification brought about by the influx of Mississippi River water, and of the high content of suspended organic material in the areas close to the Delta.

The shells of several specimens of *Callocardia texasiana* had

been attacked by a worm similar to the *Polydora* which often infests commercial oysters (Hofstetter, 1965, p. 19). The pallial sinus of one valve was completely riddled by this shell inhabitant.

Dead valves of *Callocardia texasiana* which have been drilled by a predatory gastropod are occasionally found. The geometry of such drill holes may be used to identify the predator; this method has even been applied to fossil shells (Siler, 1965). The smooth, hemispherical drill holes found in our *Callocardia* shells are the work of a naticid gastropod, most likely the common *Polinices duplicatus*.

Acknowledgments. The author wishes to acknowledge the support of a National Aeronautics and Space Administration Fellowship and of National Science Foundation Grant GP-3600. Dr. T. E. Pulley, Houston Museum of Natural Science, critically read the manuscript.

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A NEW ANCILLA FROM BRAZIL

BY JOHN Q. AND ROSE L. BURCH

Among specimens received from Fortaleza, Ceara, Brazil, there are some specimens of *Ancilla* that seem to us to be a new species. The shells were taken from the digestive tract of the toad fish *Amphichthys cryptocentrus* (Valenciennes 1837) in the family Batrachoididae. The fish was taken in about fifteen fathoms. They are bottom feeders.

ANCILLA MATTHEWSI, new species.

Figure 1

Shell fusiform, greatest width at middle of body whorl; spire high, smooth, pointed; callus expanding on body whorl, but not covering the preceding suture; 3 or 4 plaits on base of columella; columella excavately arched then slightly twisted; minute vertical striations on body whorl; two spiral basal grooves, the lower groove

starting at the notch and ending at columella with a small plait on interior, the upper groove pitted with rib-like nodes; outer lip with minute tooth before turn at base; shell orange, but some paratypes apricot or white. Dimensions of the holotype are, length 18.8 mm., length of aperture 12.4 mm., width 9.1 mm.

The dimensions of the paratypes vary from length 20.1 mm., length of aperture 11.9 mm., width 8.7 mm. to length 11.9 mm., length of aperture 5.0 mm., width 5.0 mm.

This species may be compared with *Ancilla cinnamonea* Lamarck 1801, in form alone, but the latter lacks the basal grooves.

The holotype is to be deposited in the Academy of Natural Sciences of Philadelphia, no. 308959. Two paratypes are in the collection of Mr. H. R. Matthews, two paratypes, no. 308960, in the collection of the Academy of Natural Sciences of Philadelphia, two in the Burch collection, and others will be distributed to various institutions.

It is our pleasure to name this species in honor of Mr. H. R. Matthews, British Vice-Consul in Fortaleza. His enthusiasm in research has contributed much to those interested in the malacology of this region.

We wish to thank Dr. Bruce Campbell for preparing the figures.

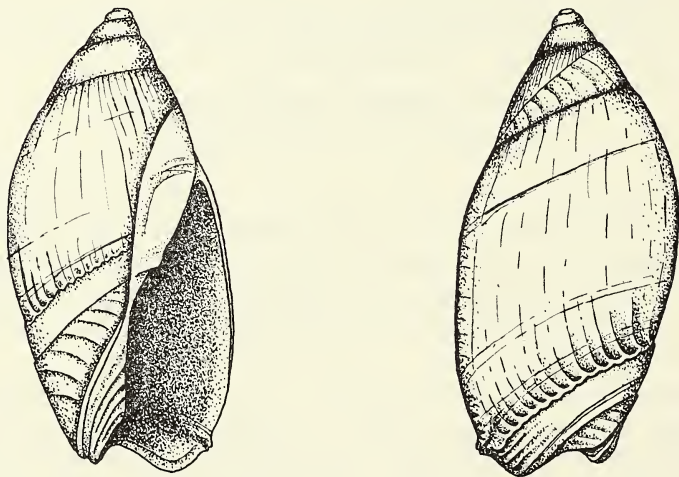


Figure 1. *Ancilla matthewsi* Burch and Burch. Two views of holotype.

A NEW SPECIES OF LYRIA (VOLUTIDAE) FROM HISPANIOLA

By W. J. CLENCH AND R. D. TURNER

Through the kindness of Dr. L. E. Vega of Santo Domingo, República Dominicana, we have been privileged to describe this new *Lyria* from Hispaniola.

Various species in the genus *Lyria* appear to be very rare in the western Atlantic. Probably no more than 5 or 6 specimens of *Lyria beauii* (F. & B.) are known to exist.

LYRIA (LYRIA) VEGAI, new species.

Page 84, fig. 1

Description: Shell relatively small for this family, though large for the genus; nearly smooth, imperforate and reaching 60 mm. (about $2\frac{1}{2}$ inches) in length. Whorls 8 and convex. Color ivory with numerous and irregular spiral bands of brownish spots and lines which are also in axial arrangement. Spire extended and produced at an angle of 48° . Aperture subelliptical. Outer lip slightly reflected. Parietal wall thinly glazed. Columella with two well developed plicae and one small one near the base and with several exceedingly fine, thread-like plicae above which extend over the parietal wall. Suture well indented. Sculpture consisting of very fine axial costae on the early whorls which are absent on the later whorls which have only very fine growth lines. Protoconch broken. Operculum unknown.

Measurements of holotype: Height 60 mm., width 26 mm.

Type: Holotype, Museum of Comparative Zoology, no. 256494, from a fishtrap, Cabo Rojo, Prov. Pedernales, República Dominicana, Hispaniola. Collected by Bernardo Vega in December 1961.

Remarks: This species is related to *Lyria beauii* (Fischer and Bernardi) from Marie-Galante, Lesser Antilles, though it differs in several of its morphological characters from that species. *Lyria vegai* is smooth except for the first two whorls, and not axially ribbed throughout as in *beauii*; also the outer lip is more rounded. In addition, *L. vegai* has only the columellar plicae and 3 or 4 very small plicae at the upper parietal area, while *beauii* has a continuous series of small plicae which extend from the columellar area to nearly the uppermost portion of the parietal area.

Named for Dr. L. E. Vega of Ciudad Santo Domingo.

LYRIA (LYRIA) BEAUII (Fischer and Bernardi)

Figs. 2-3

Voluta beauii Fischer and Bernardi 1857, Jour. de Conchyliol-

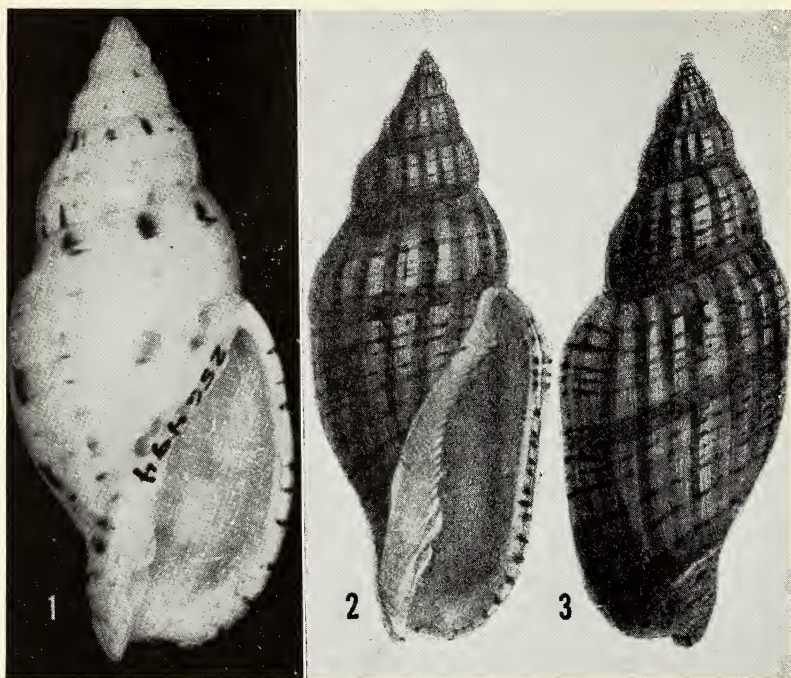


Figure 1. *Lyria (Lyria) vegai* Clench and Turner (14X). Figures 2-3. *Lyria (Lyria) beauii* (Fischer and Bernardi) (about natural size) [after Fischer and Bernardi].

ogie 5: 296, pl. 9, figs. 8-9 (Marie-Galante [Lesser Antilles] West Indies).

Lyria beauii (Fischer and Bernardi). Tryon 1882, Man. of Conch. (1) 4: 101, pl. 2, fig. 7 (radula); pl. 31, fig. 137.

THRACIA CONRADI IN MALPEQUE BAY, PRINCE EDWARD ISLAND

By M.L.H. THOMAS

Fisheries Research Board of Canada, Biological Substation, Ellerslie, P.E.I.

Thracia conradi Couthouy, a bivalve mollusk of the family Thraciidae, order Anomalodesmacea, has seldom been collected alive because of its deep burrowing habit and its delicate shell. Consequently its geographical range is not completely known and its biological characteristics are known even less. Johnson (1934) gave the range as Labrador to North Carolina in 3-16 fm. Most

later general accounts merely repeat this information (Smith, 1937, Miner, 1950 and LaRocque, 1953) but Abbott (1954) gives the range as Nova Scotia to Long Island Sound, N. Y. in water down to 150 fm. Canadian records, mostly from Whiteaves (1901, were summarized by LaRocque (1953) but unfortunately several significant records by Stafford (1910a, 1910b) were not included. These records show a distribution extending from U.S.A. waters as far north as Caribou Island, Labrador and up the St. Lawrence to Gaspé Bay, P.Q. There are several records for the mainland side of Northumberland Strait but none for P.E.I. waters. Most of these records are based on shells only.

A few observations on habitat and general biology of *T. conradi* are included in the records discussed above but the only papers giving any details of this aspect are those of Gould (1870) and Morse (1913, 1919) who did observe living specimens.

During recent faunal surveys of Malpeque Bay, P.E.I. it has been established that *T. conradi* is common in the area. It has a wide distribution in the bay proper and occurs to at least the lower parts of tributary estuarine waters. It has not been found where salinity ever would be greatly reduced, although specimens retained in the laboratory have withstood temporary fresh-water conditions lasting several hours.

Bottoms in which populations have been found have all been of muddy sand, with the proportion of mud varying considerably. However, in all locations the sediment was similar in that it was firm with little tendency to shift. Eel grass *Zostera marina* L. was abundant at some stations and absent at others.

One abundant population was examined using skin diving (SCUBA) methods. This location was typical for populations in the area and comprised a bottom of slightly muddy sand in about 4 meters of water. The bottom at this station was covered with numerous paired holes which proved to be *T. conradi* burrows. The main associated molluscan fauna comprised *Pitar morrhuana*, *Tellina agilis*, *Ensis directus*, *Lacuna vincta* and *Nassarius trivittatus*.

Numerous specimens were carefully dug by hand and with a hand operated suction dredge (Brett, 1964). Where possible, individuals were marked in situ, their position recorded and the burrow depth measured. Specimens were measured and weighed entire

while still alive.

Specimens collected measured up to 91 mm. long and weighed up to 162 grams. Each individual had two burrows to the surface, emerging up to about 80 mm. apart. Both burrows were round in cross section; that for the incurrent (ventral) siphon characteristically being surrounded by a mound of excavated sand, whereas the excurrent siphon hole lay in a depression. Both burrows descended almost vertically to a few centimeters above the clam, then converged to form a common chamber at the posterior end of the shell. Burrow depths to the uppermost part of the shell were measured for many specimens over 53 mm. long. I observed that the burrow depth was not proportional to size but varied randomly from 140 to 260 mm., a mean of about 175 mm. Several specimens smaller than 53 mm. in length have been collected by the suction dredge but none were observed in their burrows. All specimens examined *in situ* were lying on their sides with the larger right valve up.

Several specimens from 55 to 89 mm. long have been held alive in the laboratory in containers of muddy sand. One has been observed for several months with its burrows against the glass wall of a container. In the laboratory all specimens fed freely on a culture of marine diatom *Phaeodactylum tricornutum* Bohlin.

Specimens observed in the laboratory made no attempt to burrow or even move. However, those placed in a typical attitude and depth in sand quickly constructed siphon holes to the surface and fed when food was provided. In the laboratory siphon holes have rarely been retained unaltered for more than a day, being re-dug frequently and changed in position. During this re-working process a considerable volume of sediment was transferred from the excurrent to the incurrent siphon burrow where it built up at the surface. Specimens periodically allowed both burrows to collapse and fill and remained quiescent for periods of up to a week. Such action also resulted when fresh water replaced the sea water flow. There is evidence, however, that some water was still drawn in through the sand when the holes were blocked, since addition of food culture or return of full salinity resulted in prompt re-burrowing to the surface.

The field and laboratory observations of living specimens, both buried and free, and the diminutive size of the foot, suggest that

adult specimens do not move once established in a burrow.

I must conclude that *T. conradi* has a much more general distribution and is probably much more abundant throughout its range than references indicate. Studies on its mode of life, behavior and general biology suggest a fascinating life history. Further studies would no doubt be rewarding.

I am grateful to Dr. A. H. Clarke of the National Museum of Canada for his help and advice and for checking the identity of specimens.

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NOTES ON COASTAL LAND SNAILS

By ROBERT R. TALMADGE

Willow Creek, California

A recent paper by Bleakney, Nautilus 79 (4), April, 1966, on the availability of calcium carbonate for *Cepaea nemoralis* on an offshore island off Nova Scotia, supplied the incentive for this rather brief discussion on similar coastal situations, but along the

coasts of northern California and southern Oregon. There are numerous headlands, offshore islets and sea stacks along the coasts mentioned above, many of which have a vegetation cover. Some of them also have local populations of slugs and snails in the genera *Ariolimax*, *Haplotrema*, *Vespericola*, and *Monadenia*, the latter having been the subject of several taxonomic papers covering insular, headland, or beach populations.

The vegetation cover mentioned may consist of grass only, grass and low brush, grass brush and trees, or any combination of such, dependent upon the size, soil, and exposure to the prevailing winds of any stack, islet, or headland. At least in my field records, there does not appear to be any definite trend of snail populations dependent upon any special type of vegetation or size of headland or islet. Apparently the availability of free lime, plus cover from the strong prevailing winds were the two prime factors of abundance and distribution.

Bleakney refers to the use of lime from the drift or bird taken marine shells that the snails found on the island. This appears to be duplicated on the South and Middle Sisters Rocks, south of Port Orford, Oregon. At the present time, one may easily reach the headland on the mainland and the South or innermost Sister Rock, and the Middle Sister at low-low tide. North Sister, a nearly vertical sea stack cannot be reached except by boat, and then the possibility of climbing the sides is questionable. The only noticeable lime about the two inshore rocks and the mainland headland appears to be either drift shells or shells that gulls have left amid certain rocky areas rather low down on the tall stacks. There is a population of a rather small *Monadenia*, as well as small *Vespericola* and some *Haplotrema* also low down on these rocks, living in the grasses rather than in the available low brush. The population is not noted as being very heavy.

The reef, sea stack, insular, and headland complex near Trinidad, and at Crescent City in northern California is quite different. Some of the localities that appear the least suitable for land snails have a much heavier population than sites one would consider more suitable. I did note that in the areas of the greatest number of land snails, there were deposits of sandy soil, filled with subfossil marine shells, and that the snails appeared to be concentrated in the heavy rank grass at or adjacent to such lime areas. Guano also

appeared to be a factor in furnishing lime. Prehistoric sand dunes filled with old marine shells are also a possible source of lime, and such seem to support a much larger population of land snails. Such sites are the mouth and lower reaches of the Pistol River in Oregon, the Smith and Mad Rivers in California. In such areas snails are to be found well into the dunes, even in what many might consider to be poor vegetation cover.

Shell mounds, or Indian middens, with the loose soil, filled with bits of broken clam shell, also furnish free lime to the snails. Personal observations indicate that the snail populations around such sites are more dense than in similar vegetation cover nearby.

The majority of the reef, sea stack, insular, headland complexes, appear to be remnants of more massive headlands that were separated, broken apart, or worn into more or less their present condition by the rise and fall of the sea level during the glacial and interglacial periods of the Pleistocene. Most paleontologists consider that our present genera of land snails were present and had a similar distribution during that geological time. There are areas that have altered since the glacial periods to such an extent that land snails may no longer inhabit the region, or else other species have moved in, replacing the original forms. At the present time, apparently the insular and headland races of *Monadenia*, *Vespericola*, and *Haplotrema* on the Pacific Coast, were present prior to this breaking up of the larger headlands, and survived in suitable locations that furnished them with cover, food, and lime.

SNAILS ON MIGRATORY BIRDS

By DEE S. DUNDEE, Louisiana State University in New Orleans,

PAUL H. PHILLIPS and JOHN D. NEWSOM, Louisiana State

University, Baton Rouge

During nocturnal woodcock-banding operations by the Louisiana Cooperative Wildlife Research Unit in the winters of 1964-65 and 1965-66, snails (*Succinea unicolor* Tryon) were found among the feathers of some of these migratory birds. The banding was done in the Atchafalaya River Basin area in Louisiana.

Various birds were caught during these operations but snails were found on only 3 species: woodcock (*Philohola minor*), common snipe (*Cappella gallinago*), and whippoorwill (*Caprimulgus vociferous*). Since the banding was primarily aimed at woodcock,

only the snails found on them were given special attention.

During the 1964-65 winter, 2754 woodcock were banded and in 1965-66 the number was 1103. The first season the number of snails per bird ranged from 1 to 14 and during the second year it dropped to from 1 to 8. The drop was most likely due to a long drought which was not broken until mid-December. During 1965-66 banding program every 10th woodcock was weighed, sexed, aged, and checked for snails. Of the 96 woodcock checked, 11.4% had snails present. Of those, the average number of snails per bird was 3. There seems to be no correlation as to age of bird, sex, size and the age of the snail. Snails involved in these associations ranged in size from 1.5—9.0 mm. It seems to be purely a matter of chance as to whether any particular bird has on it any particular snail.

The snails were found at different positions on the birds. Some were at the base of the feathers on the upper breast, mid-breast, and low breast; others were at feather bases under the anterior feathers of the mid-abdomen between the legs; some were on the outside of the tibio-fibula, on the outside of flank feathers at the base of the tail, on the underside of feathers outside of the tibio-tarsus, and at the base of the undertail coverts. In no case were the snails on the dorsal surface of the birds.

Why are these Succineids on the woodcocks? At this point there is no answer; only hypotheses. Since the woodcock is a nocturnal feeder whose diet is composed almost exclusively of earthworms, it needs damp or even wet soil to facilitate probing for the worms. Thus, perhaps it is mere chance that the snails happen to crawl onto the bird while it is sitting in their locality. Perhaps the warmth of the bird attracts the snails. Since the snails, in most cases, were taken from the *base* of the feathers, perhaps the snails are feeding on some material at that point. The reason remains to be determined.

In any case, these are not the only records of the occurrence of snails on migratory birds. Rees (1965), in summarizing the work of others, points out that *Physa* sp. has been found on the upland plover (*Bartramia longicauda*) and *Succinea riisei* (Pfeiffer) on the bobolink (*Dolichonyx oryzivorus*) and on the western vesper sparrow (*Poocetes gramineus*). All these birds are migrants also.

Recaptures of the banded woodcock have occurred in many places in their migratory range: Ontario, Michigan, Massachusetts,

etc. Here, again, is evidence of one of the means of distribution of our molluscan fauna. We have no records of snails on these recaptures since there is no program of examination for snails after recapture. Such would be ideal.

We owe thanks to Mr. Don J. Bethancourt of the Louisiana State University School of Forestry and Wildlife Management for his aid with this paper.

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NEW AND OLDEST RECORDS OF PELECYPOD MYA FROM WEST NORTH AMERICA, SOUTH OF ALASKA

By OLUWAFEYISOLA S. ADEGOKE

Department of Paleontology, University of California, Berkeley¹

During a detailed biostratigraphic study of the Neogene Formations of the Coalinga region, California, the writer collected two specimens of the pelecypod *Mya* (figs. 1-3) from the middle of the Middle Miocene Temblor Formation. The significance of these occurrences, constituting the oldest known records of the genus from the northeastern Pacific, south of Alaska, and their bearing on the evolutionary history and the biogeography of the genus are discussed briefly below.

The earliest recorded occurrences of *Mya* in America are from the upper part of the *Acila shumardi* zone (Middle Oligocene) of Popof Island, south of the Alaskan Peninsula, and from the lowermost part of the Poul Creek Formation of the Yakataga district, Alaska (MacNeil, 1965, p. G14). This oldest American species was identified as *Mya kusiroensis* Nagao and Inoue 1941, by MacNeil, who regarded the species as a trans-Arctic migrant from the western Pacific (MacNeil, *op. cit.*, p. G2). The same species occurs in Middle Oligocene strata of Hokkaido, Japan (Fujie, 1957; 1962), and is believed to have evolved directly from *Mya ezoensis* Nagao and Inoue, a species known from the Late Eocene or Early Oligocene Wakkanabe Formation of Hokkaido, Japan (MacNeil, 1955, pp. G13-14). In addition, MacNeil (*op. cit.*) has recognized *Mya salmonsensis* Clark and a doubtful occurrence of *M. grewingki* Makiyama from the middle and upper parts of the

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Poul Creek Formation (Late Oligocene and Early Miocene) of Alaska. These species are abundant in chronologically equivalent strata in Hokkaido and Sakhalin, and the latter persisted until Middle Miocene times in Hokkaido. However, none of these species had ever been recorded from other parts of western North America, outside of Alaska.

To date, the oldest indisputable western North American record of species of *Mya* from outcropping strata south of Alaska² is *Mya fujiei* MacNeil, 1965 (see MacNeil, *op. cit.*, p. G30).

The holotype of this species came from the Takinoue Formation (early Middle Miocene) of Hokkaido (see Fujie, 1957; 1962; MacNeil, 1965, p. G14). The single Californian specimen doubtfully referred to the species by MacNeil was collected from the Briones Sandstone (Late Miocene) of the San Pablo Bay area (Univ. Calif. Mus. Paleo. locality 197). This specimen had earlier been designated as one of the paratypes of *Mya dickersoni* by Clark (1915, p. 478, pl. 63, fig. 4).

The Middle Miocene specimens collected by the writer from the Temblor Formation of the Coalinga area are shown in figures 1-3. They have relatively elongate anterior and posterior dorsal margins, and broadly rounded anterior and posterior extremities. They are tentatively identified as *Mya* (*Arenomya*) *fujiei* MacNeil, though they appear to be morphologically intermediate between the latter and *M. kusiroensis* Nagao and Inoue. They are slightly less bulky and more slender than *M. kusiroensis*, but not quite so elongate or acutely tapering posteriorly as *M. fujiei*. Inasmuch as the spoons of these Temblor specimens could not be prepared without doing considerable damage to the valves, the affinities of the species could not be more accurately determined here.

The following fossil taxons occur at the two localities in association with *M. fujiei*:

Locality B-7085. Temblor Formation, Joaquin Rocks Quadrangle, T.19S., R.15E., Section 21. N.W. $\frac{1}{4}$ of S.W. $\frac{1}{4}$ of Sec. 21. From *Vaquerosella*-bearing resistant ledges outcropping near the

²Specimens earlier reported as *Mya* n. sp.? by Loel and Corey (1932, p. 233, pl. 45, fig. 2) from the Vaqueros Formation, Plano Trabudo, Santa Ana Mountains, Orange County, California (Univ. Calif. Mus. Paleo. loc. 6128) were apparently misidentified. The figured hypotype (UCMP no. 31844) was examined by the writer. The specimen was poorly preserved and badly crushed. Despite this, characters such as the subquadrate outline, nature of the hinge, and the thin, flat valves show that it is certainly not a *Mya* but a Tellinid.

hill top on the east side and just south of the junction of a north-south dirt road with an east-west dirt road from Oil Canyon.

Asteroidea

Astropecten sp. indet.?

Pelecypoda

Aequipecten andersoni (Arnold)

Amiantis diabloensis (Anderson)

Anadara (*Scapharca*) *obispoana* (Conrad)

Anadara (*Anadara*) *osmonti* (Dall)

Psammotreta biangulata (Carpenter)

Chione temblorensis Anderson

Clementia (*Egesta*) *pertenuis* (Gabb)

Dosinia margaritana Wiedey

Lucinoma acutilineata (Conrad)

Macoma piercei Arnold

Mactra sectoris Anderson and Martin

Miltha sanctaecrucis (Arnold)

Mytilus mathewsonii expansus Arnold

Ostrea ashleyi Hertlein

Ostrea sp. indet.

Pseudocardium panzanum (Loel and Corey)

Zirfaea dentata Gabb

Gastropoda

Calliostoma pacificum Anderson and Martin

Calyptrea filosa (Gabb)

Calyptrea inornata (Gabb)

Cancellaria dalliana Anderson

Neverita reclusiana Deshayes

Sinum sp. indet.

Tritonalia topangensis (Arnold)

Forreria gabbianum cancellarioides (Arnold)

Turritella ocoyana Conrad

Brachiopoda

Discinisca loeli Hertlein and Grant

Porifera

Cliona sp. indet.

Annelida

Serpula sp. indet.

Locality D-1059. Temblor Formation, Reef Ridge Quadrangle, T.23S., R. 16E., Section 3: 1,085 feet north, 1,390 feet west. From lowest two of the four prominent *Turritella* beds that crop out on the north bank of Garza Creek, a few feet above the creek bed.

Pelecypoda

Aequipecten andersoni (Arnold)

Anadara (*Anadara*) *osmonti* (Dall)

Psammotreta biangulata (Carpenter)

Diplodonta orbella Gould
Macoma nasuta Conrad
Pseudocardium densatum minor (Arnold)
Semele morani Anderson and Martin
Solen gravidus Clark
Spisula albaria Conrad
Tellina ocoyana Conrad
Trachycardium vaquerosense (Arnold)
Transennella joaquinensis Anderson and Martin
Zirfaea dentata Gabb

Gastropoda

Bruclarkia barkerianum santacruzianum (Arnold)
Crepidula rostralis (Conrad)
Tritonalia topangensis (Arnold)
Forreria gabbianum cancellarioides (Arnold)
Turritella bosei Hertlein and Jordan
Turritella ocoyana Conrad
Turritella wittichi Hertlein and Jordan

Discussion and inferences. The fauna associated with *Mya fujiei* MacNeil at both localities (see above) are interesting and significant in that a number of the genera represented are commonly regarded as indicators of a warm (tropical-subtropical) climate (see Smith, 1919; Durham, 1950, p. 1256). Such genera include *Anadara*, *Chione*, *Dosinia*, *Miltha*, *Clementia*, *Psammotreta*, *Semele*, and *Turritella*. The abundant occurrences of these genera in the Early Miocene faunas of this region was taken by Durham (1950, p. 1256) as indicative of a minimum water surface temperature of 19° or 20° C. Living representatives of *Forreria* and *Miltha* live today in tropical waters with a minimum surface temperature of about 20° C. MacNeil (*op. cit.*, p. G30) similarly noted that Fujie's (1962, p. 404) assignment of the Japanese representatives of *M. fujiei* implied that the species was a warm-water form. This, and the present records of *Mya* in the Temblor Formation in association with taxa with apparently tropical affinities indicate that the latitudinal restriction to cold climates characteristic of the distribution of *Mya* today is not in harmony with the latitudinal distribution of the genus in the geologic past. Most of the older species (including all the California Late Miocene species mentioned below) appear to have been tolerant to a greater range of climatic variations than are the modern representatives of the genus.

Apart from *Mya fujiei*, MacNeil (*op. cit.*) recognized the fol-

lowing species from the Late Miocene San Pablo Group of California: *M. arrosis* MacNeil 1965 (Briones, Cierbo and Neroly Formations), *M. dickersoni* Clark 1915 (Neroly Formation), and *M. arenaria* Linnaeus 1758 (Late Miocene to Recent). According to MacNeil (*op. cit.*, p. G15), *M. arrosis* evolved from *M. fujiei*, and the former is directly ancestral to *M. japonica* Jay.

The present Middle Miocene record of *M. fujiei* MacNeil is significant in that it supplies another stage in the evolution of the California Late Miocene species from the Alaskan and Japanese Early Miocene form such as *M. kusiroensis* Nagao and Inoue. These records further indicate that southerly migrations of *Mya* from Alaska probably occurred in pre-Middle Miocene times. More careful search in Lower and Middle Miocene strata especially in Oregon and Washington may reveal the occurrences of still older species.

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MURICANTHUS MELANAMATHOS, A WEST AFRICAN MURICID

By ANTHONY D'ATTILIO

Associate, American Museum of Natural History

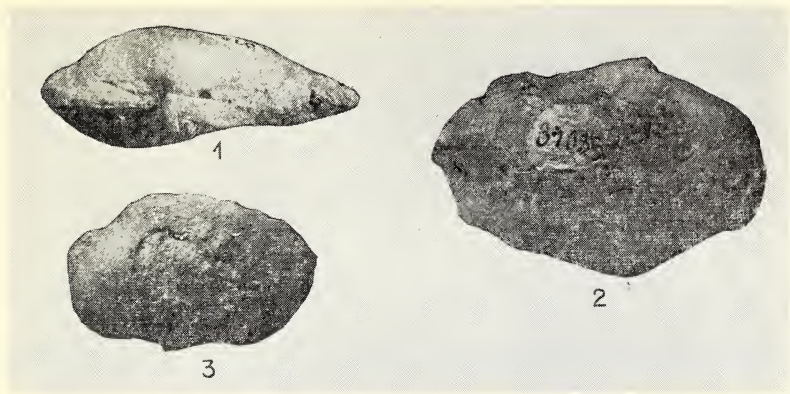
Through the generosity of Mr. Israel Bendersky, of the New York Shell Club, I received a muricid specimen which has proved to be of more than ordinary interest. Its identity was easily established as it agrees with numerous published figures of *Murex melanamathos* Gmelin. However, because of its apparent rarity, the true locality of this species has remained questionable until the discovery of the present specimen. This specimen, with a few other mollusks, was sent to Mr. Bendersky from Lobito, Angola on the west coast of Africa. The collector, a skin diver, stated that the specimen had been found by him in the vicinity of Lobito.

I should like to thank my colleague, Mr. William E. Old, Jr., for bibliographic assistance. Dr. R. Tucker Abbott kindly read the manuscript and provided helpful information.

Annotated Synonymy of *Murex melanamathos* Gmelin,

Pl. 5, Figs. 1, 2

- 1791, Gmelin, J. F. *Systema naturae*, ed. 13, *Murex*, p. 3527, sp. 9. For a figure Gmelin refers to Martini, *Conchylien Cabinet*, vol. 3, pl. 108, fig. 1015, locality "East Indies." This drawing, though poorly executed, is a recognizable illustration of this species.
- 1798, Röding, P. F. *Museum Boltenianum*, pt. 2, p. 141, no. 1776, as *Purpura tuberosa* Röding. Refers to Martini, vol. 3, pl. 108, fig. 1015.
- 1801, Bosc, L. A. G. *Histoire naturelle des coq.*, vol. 4, p. 207. Refers to Martini, (vol. 3, pl. 108, fig. 1015).
- 1807, von Waldheim, G. Fischer. *Muséum Dénidoff*, Moscow, vol. 3, p. 194. Refers to Martini, vol. 3, pl. 108, fig. 1015; [*teste* R. T. Abbott].
- 1816, Lamarck, M. *Encyclopédie et Méthodique*, pl. 418, fig. 2b. A passable figure, as *M. melanomathos* (sic.).
- 1817, Dillwyn, L. W. *Descriptive catalog of recent shells*, vol. 2, p. 686, [*sp.*] 11, East Indian Seas, as *M. melanomathos* (sic.). Besides referring to Gmelin, Dillwyn cites, Schroeter, *Einl.*, i, p. 548; Argenville, *Zoom t.* 11, fig. K; and D'Avila, t. 15, fig. H.
- 1818, Wood, W. *Index testaceologicus or a catalogue of shells*, p. 120, no. 11, East Indian Seas, as *M. melanomathos* (sic.). Refers to Martini, vol. 3, pl. 108, fig. 1015.
- 1828, Wood, W. *Index testaceologicus or a catalogue of shells*, p. 120, pl. 25, fig. 11, East Indian Seas. This very small figure may be taken to illustrate the species.



Figures 1-3. *Mya (Arenomya) fujiei* MacNeil. Temblor Formation, Coalinga, California. 1, 2, hinge and side views of Univ. Calif. Mus. Palco. no. 36779, locality B-7085, X 1. 3. side view of Univ. Calif. Mus. Palco. no. 37680, locality D-1059, X 1.

1828, Sowerby, G. B. Jun. Genera of recent and fossil shells, vol. 2, pt. 30, *Murex*, fig. 6. This is an excellent figure of this species which was presented in this work as an example of the genus *Murex*.

1843, Kiener, L. C. Coquilles vivantes, *Murex*, pp. 62-63, pl. 29, fig. 2-2. The species is well figured in this work and Kiener notes that specimens were to be found in the collection of Lamarck, with the locality: Indian Ocean, as *M. melanomathos* (*sic.*).

1845, Reeve, L. A. Conchologia iconica, vol. 3, *Murex*, species 48. An excellent figure, but no locality is given, as *M. melanomathos* (*sic.*).

1878, Küster, H. C. and Kobelt, W. Conchylien cabinet, *Murex*, pp. 12-13, pl. 4, fig. 5, pl. 4b, fig. 3, Indian Ocean, as *M. melanomathos* (*sic.*).

1879, Sowerby, G. B. Thesaurus conchyliorum, *Murex*, p. 30, sp. 13, fig. 144, Habitat?

1880, Tryon, G. W. [in part]. Manual of conchology, Muricinae and Purpurinae, pl. 26, fig. 230. Tryon incorrectly synonymizes *Murex melanomathos* (*sic.*) with *Murex oxyacantha* Broderip, 1833, and cites the locality as Real Llejos, west Central America (now known as Corinto, Nicaragua).

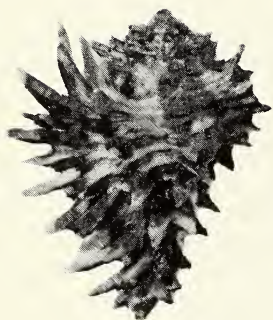
Discussion. The specimen from Lobito agrees generally with Reeve's (1845) excellent figure of this taxon, but it has only 7 varices instead of 8 as shown by that author. The shell is white with black varices and spines. The spines are comparatively short and develop as the ends of 5 major spiral cords on the body whorl



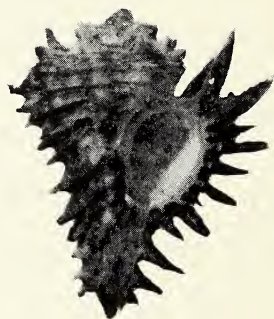
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Figs. 1, 2. *Muricanthus melanamathos* (Gmelin), Lobito, Angola, Africa.
Figs. 3, 4. *M. oxyacantha* (Broderip), San Juan del Sur, Nicaragua. Both $\times 1$.

and one major cord on the canal. Between these major cords there are present secondary and lesser cords. Spiral cords and spines occur on the shoulder close to the suture.

Muricanthus oxyacantha (Broderip, 1833), on the other hand, has many more major spiral cords, the shell is mostly white with the spines commonly stained with a little brown. The cords and spines are wanting on the region above the shoulder to the suture, and there are only a few minor cords between the major ones (see pl. 5, figs. 3, 4). Keen (1958, p. 356) noted in her remarks to *M. oxyacantha* "the species has been identified as *Murex melanamathos* Gmelin, 1791 by some authors, but that form, which is apparently Indo-Pacific in distribution, has black spines on all eight varices, and the published figures show spines above the aperture that are lacking in *M. oxyacantha*."

That a species from west Central America should find a counterpart in west Africa is not surprising considering the presence on the west African coast of a number of species that have twin species in the tropical west American and the eastern American regions. As for one example, in the Muricidae, *Purpurellus pinniger* (Broderip) of the Panamic province is very similar in conchological characters to *Purpurellus gambiensis* (Reeve) from west Africa.

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- Broderip, W. J., 1833. Characters of new species of Mollusca and Conchifera. p. 176, Hab. in America Centrali (Real Lleijs).
Murex oxyacantha was first illustrated in the following work:
Sowerby, G. B. Jun., 1834. The conchological illustrations, *Murex*, A catalogue of recent species, sp. 80, pl. 59, fig. 11.
Keen, M., 1958. Sea shells of tropical west America, p. 356, sp. 345.

FRESHWATER MOLLUSCA FROM JAMES RIVER, VA. AND A NEW NAME FOR MUDALIA OF AUTHORS.

BY WILLIAM J. CLENCH AND KENNETH J. BOSS

While on our way to the American Malacological Union meetings in Chapel Hill (1966), the authors and Mr. Morris K. Jacobson of New York collected along the central reaches of the James River, Virginia. Four stations were made, three in the James and one in a tributary, the Rivanna River near Columbia. Good fortune was with us because the river was low and clear, two most important factors in fresh water collecting.

Twenty to forty miles west of Richmond, where we made most

of our stations, the James River was over 300 feet wide but rather shallow, probably not more than 10-15 feet deep in the main channel of the stream and about 2 or 3 feet deep for much of its area. The substrate of the river is largely sand with extensive patches of smooth flattened boulders or rocks and with occasional areas of gravel; much of the bank was soft black mud.

We are indebted to Mr. R. I. Johnson for the determination of several species of the Unionidae.

Stations made in the James River System on August 21, 1966. (Museum of Comparative Zoology, Mollusk Department Field Numbers)

2288, James River, Powhattan County, across the river from Maidens, Goochland County, Virginia.

2289, James River, near Cartersville, Cumberland County, Virginia.

2290, James River, near Columbia, Fluvanna County, Virginia.

2291, Rivanna River, 2 miles west of Columbia, Fluvanna County, Virginia.

LIST OF THE SPECIES

Viviparidae

Lioplax subcarinata (Say, 1817), Stations 2288, 2289.

Campeloma lima (Anthony, 1860), Stations 2288, 2289, 2290.

Hydrobiidae

Gillia altilis (Lea, 1841), Stations 2288, 2289, 2290.

Pleuroceridae

Goniobasis virginica (Gmelin, 1791), Stations 2288, 2289, 2290.

Anculosa (Alleghenya) carinata (Bruguière, 1789), Stations 2288, 2289, 2291.

Planorbidae

Helisoma anceps (Menke, 1830), Station 2291.

Physidae

Physa inflata Lea, 1841, Stations 2289, 2290, 2291.

Sphaeriidae

Sphaerium striatinum (Lamarck, 1818), Station 2288.

Unionidae

Lexingtonia subplana (Conrad, 1837), Stations 2288, 2289, 2291.

Elliptio complanata (Solander, 1786), Stations 2288, 2289, 2290, 2291.

Elliptio lanceolata (Lea, 1828), Stations 2288, 2289, 2290, 2291.

Alasmidonta undulata (Say, 1817), Stations 2288, 2289, 2291.

Lasmigona subviridis (Conrad, 1835), Stations 2288, 2289, 2291.

Strophitus undulatus (Say, 1817), Stations 2288, 2289, 2290.

Alasmidonta collina (Conrad, 1837), Stations 2288, 2291.

Unio collinus Conrad 1837, Monography of the Family Unionidae of North America, Philadelphia, no. 8, p. 65, pl. 36, fig. 2

(type-locality, North River, a branch of James River, Virginia); Conrad 1840, *Ibid.*, no. 12, p. 109, pl. 60, fig. 3.

Alasmidonta collina (Conrad). Simpson 1900, Proc. U.S. National Museum, 22:669; Simpson 1914, A Descriptive Catalogue of the Naiades, Detroit, Michigan, 1:501.

Villosa constricta (Conrad, 1838), Stations 2288, 2289.

While writing up the list of mollusks collected in the James River System, we discovered that the *Mudalia* of Haldeman 1840 has been used in error for the species complex containing *Anculosa carinata* (Bruguière 1789) and *Anculosa dilatata* (Conrad 1834). Since the only available synonym of *Mudalia* of authors *non* Haldeman 1840 is *Nitocris* H. and A. Adams, which itself is preoccupied, we propose, in accordance with the International Code of Zoological Nomenclature, the **new name**:

ALLEGHENYA.

Mudalia of authors, *non* Haldeman 1840.

Nitocris H. and A. Adams 1854, The Genera of Recent Mollusca, 1:308 (type-species, here designated, *Paludina dissimilis* Say 1819 [= *Bulimus carinatus* Bruguière 1789]. *non Nitocris* Rafinesque 1815 (Hymenoptera), Thompson 1858 (Coleoptera), Kinberg 1866 (Vermes) and Guenée 1868 (Lepidoptera).

Bulimus carinatus Bruguière 1789 is here designated as the type-species of *Alleghenya*.

Mudalia Haldeman 1840: 1) never has been given a correct type-species designation and 2) embraces a species complex widely separated geographically from the east coast-middle-western complex represented by *carinata* and *dilatata*. Most authors have claimed consistently and incorrectly that *Bulimus carinatus* Bruguière was the type-species of *Mudalia* (Hannibal, H. 1912, Proc. Malac. Soc. London, 10:168; Morrison, J. P. E. 1954, Proc. U. S. Nat. Mus., 103:361; Wenz, W. 1939, Handbuch Paläozoologie, 6 (1):701). Bruguière's name was not even used or ever mentioned by Haldeman in connection with his name *Mudalia*.

In October 1840, Haldeman introduced *Mudalia* as a subgeneric name under *Anculosa* in his Monograph of the Limniades, Supplement to No. 1, p. 1, and on p. 2 he described the species *A. (M.) turgida* without locality data; he mentioned that *A. (M.) turgida* resembled the *Paludina dissimilis* of Say. Later, he described another species of *Mudalia*, *A. (M.) affinis* Haldeman 1841, Monograph, inside of back cover of number 3. Goodrich (1932, Nauti-

lus, 46: 40) mistook the 1841 citation of *Mudalia* as the introduction of the generic name by Haldeman and considered *A. (M.) affinis* as the type-species of the genus and, further, made it a synonym of *Lithasia obovata* Say; he also suggested that the name *Nitocris* H. and A. Adams be used for the group of *A. carinata* (Bruguère) (Goodrich, C. 1942, Occ. Papers Mus. Zool., Univ. Mich., no. 456, p. 2). Haldeman ([in] Chenu 1848, Illustrations Conchyliologiques, vol. 3, *Leptoxis*, p. 5, pl. 5, fig. 151) gave the locality of *L. (Mudalia) turgida* as Alabama. We here designate *Anculosa (Mudalia) turgida* as type-species of *Mudalia* Haldeman 1840 and restrict the type-locality to the Black Warrior River, Alabama.

LOCALITIES FOR NEW BRUNSWICK LAND MOLLUSKS

BY N. J. REIGLE, JR.¹ AND H. B. HERRINGTON²

There are very few published records of the land and fresh-water mollusk fauna of the Canadian province of New Brunswick. La Rocque (1961) provided a review of the literature and a summary checklist of the non-marine mollusks of the province. Since that work Dimelow (1962) working near the Nova Scotian border has provided some additions to the faunal record and a checklist of his collection.

The authors collected in New Brunswick from September 2 to September 10, 1961. The primary purpose of his trip was to collect fresh-water mollusks, particularly Sphaeriidae; however a secondary effort was made to procure as many specimens of land mollusks as time permitted. Land mollusk collections were made near Lincoln in Sunbury and York Counties and during brief stops at various localities along Number 2 Highway and the St. John River en route from the Quebec border to Lincoln. In all, collections were made at 9 localities in 5 counties. A total of 16 species of land snails and 3 species of slugs were collected. The material has been deposited in the Museum of Zoology of the University of Michigan and the National Museum of Canada. Since many of these records are county records and due to a general lack of information concerning the distribution of New Brunswick mollusks, all land mollusks collected during the trip will be listed here.

¹ U.S. Bureau of Commercial Fisheries, Ann Arbor, Michigan.

² Westbrook, Ontario, Canada.

We would like to thank Dr. Henry van der Schalie of the Museum of Zoology, University of Michigan, for the use of facilities at his disposal and making the trip possible. Dr. Lowell L. Getz, University of Connecticut, kindly determined the species of *Dero-ceras*. Collecting expenses were defrayed in part by a research grant 2E-41, from the National Institute of Allergy and Infectious Diseases, U. S. Public Health Service.

List of species collected

Triodopsis albolabris (Say). Sunbury Co.; along Nevers Road 2.3 miles south of No. 2 Highway.

Stenotrema fraternum (Say). Sunbury Co.; along Nevers Road 2.3 miles south of No. 2 Highway and along Camp Road 2 miles south of No. 2 Highway.

Euconulus fulvus (Müller). Sunbury Co.; along Nevers Road 2.3 miles south of No. 2 Highway and along Camp Road 2 miles south of No. 2 Highway.

Zonitoides arboreus (Say). Madawaska Co.; along No. 2 Highway 4 miles south of Edmundston and along No. 2 Highway 4 miles south of Green River: Victoria Co.; along St. John River at Andover: Carleton Co.; along No. 2 Highway 2 miles north of Route 5 near Woodstock: York Co.; western edge of Lincoln: Sunbury Co.; along Baker Brook 1½ miles each of Lincoln, along Nevers Road 2.3 miles south of No. 2 Highway and along Camp Road 2 miles south of No. 2 Highway.

Oxychilus cellarius (Müller). York Co.; along St. John River at the Princess Margaret Bridge in Frederickton.

Hygromia hispida (Linne). York Co.; along St. John River at the Princess Margaret Bridge in Frederickton.

Deroceras laeve (Müller). Carleton Co.; along No. 2 Highway 2 miles north of Route 5 near Woodstock: Sunbury Co.; along Camp Road 1½ miles south of No. 2 Highway.

Deroceras reticulatum (Müller). Victoria Co.; near St. John River at Andover: Carleton Co.; along No. 2 Highway 2 miles north of Route 5 near Woodstock: York Co.; along St. John River at Princess Margaret Bridge in Frederickton and near the western edge of Lincoln: Sunbury Co.; along Baker Brook 1½ miles east of Lincoln, along Nevers Road 2.3 miles south of No. 2 Highway and along Camp Road 2 miles south of No. 2 Highway.

Anguispira alternata (Say). Victoria Co.; near the St. John River

at Andover: Carleton Co.; along No. 2 Highway 2 miles north of Route 5 near Woodstock.

Discus cronkhitei (Newcomb) var. *catskillensis* (Pilsbry). Madawaska Co.; along No. 2 Highway 4 miles south of Edmundston: Victoria Co.; near St. John River at Andover: Sunbury Co.; along Baker Brook $1\frac{1}{2}$ miles east of Lincoln, along Nevers Road 2.3 miles south of No. 2 Highway and along Camp Road 2 miles south of No. 2 Highway.

Helicodiscus parallelus (Say). Victoria Co.; near St. John River at Andover: Sunbury Co.; along Nevers Road 2.3 miles south of No. 2 Highway and along Camp Road 2 miles south of No. 2 Highway.

Arion circumscriptus (Johnston). Victoria Co.; near St. John River at Andover: Carleton Co.; along No. 2 Highway 2 miles north of Route 5 near Woodstock: York Co.; along St. John River at Princess Margaret Bridge in Frederickton and near the western edge of Lincoln: Sunbury Co.; along Baker Brook $1\frac{1}{2}$ miles east of Lincoln.

Oxyloma cf. *decampi gouldi* Pilsbry. Sunbury Co.; along Baker Brook $1\frac{1}{2}$ miles east of Lincoln.

Succinea ovalis Say. Madawaska Co.; along No. 2 Highway 4 miles south of Green River: York Co.; western edge of Lincoln: Sunbury Co.; along Baker Brook $1\frac{1}{2}$ miles east of Lincoln, along Nevers Road 2.3 miles south of No. 2 Highway and along Camp Road 2 miles south of No. 2 Highway.

Catinella avara (Say). York Co.; western edge of Lincoln: Sunbury Co.; along Baker Brook $1\frac{1}{2}$ miles east of Lincoln.

Strobilops labyrinthica (Say). Sunbury Co.; along Camp Road 2 miles south of No. 2 Highway.

Vertigo gouldi (Binney). Sunbury Co.; along Camp Road 2 miles south of No. 2 Highway.

Vallonia pulchella (Müller). Victoria Co.; near St. John River at Andover.

Cionella lubrica (Müller). Madawaska Co.; along No. 2 Highway 4 miles south of Green River: Victoria Co.; near St. John River at Andover: York Co.; along St. John River at Princess Margaret Bridge in Frederickton: Sunbury Co.; along Baker Brook $1\frac{1}{2}$ miles east of Lincoln.

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-

THIRTY-SECOND ANNUAL MEETING OF THE AMERICAN MALACOLOGICAL UNION

By MARGARET C. TESKEY, AMU. Secretary

On August 22nd to 26th, the American Malacological Union met at the University of North Carolina at Chapel Hill, North Carolina. It was the thirty-second such session and 151 members and their guests made it the best attended. The North Carolina Shell Club was co-host with the University and each hard working club member made every effort to ensure that the AMU. would never forget the 1966 annual meeting.

Dr. Ralph W. Dexter occupied the presidential chair, and during a four day period introduced the following papers:

Significance of larval development in bivalve taxonomy, Paul Chanley. An observation of captive *Murex celluosus* Conrad, Dorothy Raeihle. Care and feeding of incubated marine snails, Dorothy Raeihle. Snails on migratory birds, Dee Dundee. Small beginnings, Adlai B. Wheel. Evolutionary sequence in *Phyllodina*, Kenneth Jay Boss. Genetic and ecophenotypic relationships in northern *Andonta* populations, Arthur H. Clarke. Observations on the distribution of the naiad *Cumberlandia monodonta* (Say) 1829, David H. Stansbury. Lymnaeidae of western Montana - Taxonomy and distribution, Richard H. Russell. Commercial scalloping, anyone? Mrs. Kay Lawrence. Shell damage in the sea scallop, *Placopecten magellanicus*, Arthur S. Merrill. Oyster production and research in Tampa Bay, Lulu B. Siekman. Utilization of naides by prehistoric man in the Ohio Valley, David H. Stansbury. *Aeromonas* in the pathology of the giant African snail, Albert R. Mead (read by title). Zoogeography of Montana mollusks, Royal Bruce Brunson. Systematics and zoogeography of the Ctiloceratidae, Donald R. Moore. Zoogeography of the family Amblemidae, Joseph P. E. Morrison. Raising of *Segmentina hemisphaerula* (Benson) for the study of fasciolopsiasis, Chin-Tsong Lo. The Species Groups of African *Bulinus* S. S., J. B. Burch and Rajah Natarajan. Some

serological relationships in the African genus *Bulinus*, J. B. Burch and Gene K. Lindsay. Progress in surf clam research, 1965, Robert M. Yancey. Instant Oysters, Bill Shaw. Salinity tolerance and distribution of *Spisula solidissima*, *Mulinia lateralis* and *Rangia Cuneata* (Family Macteridae), Michael Castagna and Paul Chanley. What is the true *Spisula similus* (Say)?, Morris K. Jacobson (read by title). Land and freshwater mollusks from the outer banks of North Carolina, Dorothy E. Beetle. Population sexuality in *Anodonta* (Pelecypoda: Unionidae), William H. Heard. Preliminary report on a study of the Illinois River, William C. Starrett and Gerald Root. Some nudibranch names, Henry D. Russell.

There was a mid-week break for field trips, one group going to sea on Duke University's research vessel Eastwind, while another beach-combed and a third sought land and freshwater species in the vicinity of Durham and Raleigh. There were two informal evening sessions and the annual banquet with Scotch bonnet motif was greatly enjoyed.

The following officers were elected to serve in 1967 at which time the thirty-third annual meeting will be held in August at the National Museum of Canada, Ottawa, Ontario, Canada:

President, Leo G. Hertlein. Vice-president, Arthur H. Clarke. 2nd Vice-president, Gale G. Sphon, Jr. Secretary, Margaret C. Teskey. Treasurer, Mrs. H. B. Baker. Publications Editor, Morris Karl Jacobson. Councillors-at-Large, J. Frances Allen, Emile A. Malek, William E. Old, Jr., Robert Robertson.

NOTES AND NEWS

UNIONID INTRODUCTION IN MASSACHUSETTS: Results. — In 1958 and 1959 an experiment was begun to determine if hybridization could be brought about between *Elliptio complanata* and *E. dilatata* and between *Anodonta grandis* and *A. cataracta*, and also to observe the effects of semi-controlled gene flow between *Lampsilis radiata radiata* and *L. r. siliquoidea* (see Nautilus 73 (1) : 36-37, 1959).

Between September 5 and 8, 1958, I transferred 7 living specimens of *Elliptio dilatata*, 16 of *Anodonta grandis*, and 70 of *Lampsilis radiata siliquoidea* from Base Line Lake, Livingston Co., Michigan to a newly created reservoir-lake in the Putnamville section of Danvers, Massachusetts. On July 21, 1959, 9 living

specimens of *Elliptio complanata* from Silver Lake, Wilmington, Mass., and 14 of *Anodonta grandis* and 24 of *Lampsilis radiata radiata*, both from Wakebee-Mashpee Pond, Mashpee, Mass., were also introduced at the Danvers locality. All specimens were measured and classed for morphological characters before introduction. As a control, on September 8, 1958, 66 living specimens of *L. r. siliquoidea* from lime-rich Base Line Lake were also placed in Silver Lake, Wilmington, Mass. This was done in the hope of providing criteria for recognizing any phenotypic modifications which might result from exposure to lime-poor northeastern Massachusetts water and for separating such modifications from those which might result from genetic interchange. Both the Danvers and Wilmington lakes are in the Ipswich River System.

High water in northeastern Massachusetts prevented inspection of the Danvers specimens in the fall of 1959. The Wilmington locality was more accessible, however, and brief examination of the area of introduction revealed 8 living specimens and 3 pairs of empty valves of *L. r. siliquoidea*. The living specimens were immediately replaced. They all appeared to be paler in color than when they were first introduced.

On July 1, 1964, the Danvers locality was revisited. Although water was low and visibility was good, during two hours of careful searching no living unionids were found. Only one corroded valve of *Elliptio complanata* was seen. On May 22, 1966, the Wilmington locality was also revisited and no *L. r. siliquoidea* was seen; only the native *E. complanata* and a few *A. cataracta* were found. *L. r. siliquoidea* appears now to be absent from Silver Lake.

Water samples were also taken from both localities on May 22 and tested for hardness. The Danvers water measured only 40 p.p.m. CaCO_3 and the Wilmington water only 35 p.p.m. Water from Base Line Lake, Livingston Co., Michigan, sampled on June 5, 1966, measured 260 p.p.m. CaCO_3 , however.

Apparently the attempted introduction of the Michigan species *E. dilatata*, *A. grandis*, and *L. r. siliquoidea* into the Ipswich River System has failed and those species have not survived there. Both of the Massachusetts localities support abundant fish populations (*Perca fluviatilis flavescens*, *Esox americanus*, *Lepomis* spp., etc.) and seem to be physically suitable for unionids. Excessively soft water in these lakes appears to be the most probable cause of the

failure although it does not explain why even native Massachusetts species apparently did not survive in the Danvers reservoir. Further experiments in hybridization would be of interest.

I wish to thank Mr. John Tottenham, Museum of Zoology, University of Michigan, for kindly collecting the water sample from Base Line Lake. — A. H. CLARKE, JR.

NITOCRIS. — Rafinesque, 1815, *Analyse de la Nature*: 123 [Palermo] stated simply: "37. Nitocris R. Nomia Latr." Was this "substitution" in the sense of article 16 (a) (iii) of the code? According to (b) (ii) it apparently did not "constitute an indication," even though the usual order of synonymy was reversed. — H. B. B.

PEDRO DE MESA. — With much regret, we hear that this well known collector died Nov. 17, 1966, at the age of 86, in Manila, Philippines.

INTRODUCED SLUGS STILL SPREADING. — Through repeated collections in the same localities over a period of several years, it has been possible to observe the gradual distribution of various mollusks.

When our collecting began here in 1958, the only record of *Limax marginatus* Müller was in Shreveport, Louisiana by H. Harry in 1948. An attempt to collect more from that locality in 1949 failed. The following new records now exist: 1961: Pineville Cemetery, Pineville, Louisiana; 1962: Texas Cemetery, Shreveport, Louisiana; City Cemetery, Vicksburg, Mississippi; 1963: Vienna Cemetery, Vienna, Louisiana; vacant lot on river road near downtown Natchez, Mississippi; 1965: Delhi Cemetery, Delhi, Louisiana; Hattiesburg Cemetery, Hattiesburg, Mississippi.

Otherwise *Limax marginatus* Müller is known from: *Virginia*: Danville; Gretna; Richmond. *Arizona*: Tucson. *California*: 21 localities throughout the state. *Colorado*: Boulder. *Missouri*: greenhouse in St. Louis.

In addition, *Milax gagates* (Draparnaud) now occurs in City Cemetery in Vicksburg, *Mississippi*. Previously it was known from: *California*: 22 localities. *Virginia*: Danville. *Colorado*: Boulder greenhouse. *New Jersey*: Clifton.

Working with various introduced forms which are being transported on nursery items makes one wonder what effect the advent of plastic plants will have on introduced mollusk distributions? —
DEE S. DUNDEE,¹ Louisiana State University in New Orleans.

¹ My appreciation to U.S. Public Health Service for making possible these collections through Grant GM-07194.

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NEW BRUNSWICK SPHAERIIDAE

By H. B. HERRINGTON and N. J. REIGLE, JR.

Westbrook, Ontario, and U. S. Bureau of Commercial Fisheries,
Ann Arbor, Michigan

Little data has been published concerning the sphaeriid fauna of the Canadian province of New Brunswick. The first published record of this fauna was included in a paper by Nylander (1944) who listed *Sphaerium striatinum* in the St. John River. Athearn (1961) added *S. rhomboideum* from the St. John River and *S. sulcatum* (= *S. simile*) (see Herrington, 1965) from the Tantramar River. In his 1962 revision of the Sphaeriidae, Herrington added to the fauna 3 species of *Sphaerium*: *occidentale*, *partumeium* and *securis*; and 5 species of *Pisidium*: *adamsi*, *casertanum*, *ferrugineum*, *variabile* and *nitidum*.

This paper is based primarily on collections made by the authors in the St. John River drainage from September 2 to September 10, 1961 and by the senior author in northwestern New Brunswick from August 17 to August 23, 1960. In addition, locality data for New Brunswick Sphaeriidae in the Museum of Zoology of the University of Michigan are also included. The latter data are preceded by UMMZ. in the species list. This paper lists 15 species and one form of Sphaeriidae from New Brunswick. Five of these constitute new records for the province. Species new to the fauna of New Brunswick are *Sphaerium lacustre*, *Pisidium aequilaterale*, *P. compressum*, *P. milium* and *P. nitidum* form *pauperculum*.

We would like to thank Dr. Henry van der Schalie of the Museum of Zoology, University of Michigan, for the use of facilities at his disposal and for making the 1961 trip possible. Collecting expenses were defrayed in part by a research grant 2E-41, from the National Institute of Allergy and Infectious Diseases, U.S. Public Health Service.

Sphaerium (Musculium) lacustre (Müller). St. John River at Princess Margaret Bridge, Frederickton, York County. Baker Brook, 1½ miles East of Lincoln, Sunbury County.

Sphaerium occidentale Prime. Baker Brook, 1½ miles East of

Lincoln, Sunbury County. UMMZ: vicinity of Bay of Fundy, collector—Huntsman, August 5, 1911.

Sphaerium (Musculium) partumeium (Say). Listed by Herrington (1962).

Sphaerium rhomboideum (Say). Small tributary of the Jemseg River, $\frac{3}{4}$ mile southwest of Jemseg, Cambridge Parish, Queens County.

Sphaerium (Musculium) securis Prime. Listed by Herrington (1962). UMMZ: vicinity of Bay of Fundy, collector—Huntsman, August 5, 1911.

Sphaerium striatinum (Lamarck). Oromocto River, $1\frac{1}{2}$ miles East of the south end of Sunpoke Lake, Lincoln Parish, Sunbury County. Grand Lake at Waterboro, Queens County. UMMZ: vicinity of Bay of Fundy, collector—Huntsman, August 5, 1911. Petitcodiac River at River Glade, 19 miles WSW, of Moncton, collector—A. H. Clarke, June 22, 1960.

Sphaerium simile (Say). Listed by Athearn (1961).

Psidium adamsi Prime. Baker Brook, $1\frac{1}{2}$ miles East of Lincoln, Sunbury County. UMMZ: Crecy Lake, Charlotte County, collector—M. W. Smith, May-August, 1954.

Psidium aequilaterale Prime. St. John River at McNally Ferry, Kingsclear Parish, York County. St. John River at McKinley Ferry, Kingsclear Parish, York County. St. John River at Princess Margaret Bridge, Frederickton, York County. Baker Brook, $1\frac{1}{2}$ miles East of Lincoln, Sunbury County. Oromocto River, $\frac{1}{4}$ mile East of the south end of Sunpoke Lake, Lincoln Parish, Sunbury County. Small tributary of the Jemseg River, $\frac{3}{4}$ mile Southwest of Jemseg, Cambridge Parish, Queens County. UMMZ: Trout Creek, just East of Sussex, collector—A. H. Clarke, June 25, 1960.

Psidium casertanum (Poli). Small pond on road to Beaconsfield, Andover Parish, Victoria County. St. John River at McKinley Ferry, Kingsclear Parish, York County. Baker Brook, $1\frac{1}{2}$ miles East of Lincoln, Sunbury County. UMMZ: Gas well pool near Frederick, Albert County, August 25, 1940. Crecy Lake, Charlotte County, collector—M. W. Smith, 1954. Trout Creek just East of Sussex, collector—A. H. Clarke, June 25, 1960.

Psidium compressum Prime. Aroostock River, $\frac{1}{2}$ mile above mouth at No. 2 Highway, Andover Parish, Victoria County. Little Presquisle River below sawmill at Waterville, Wakefield Parish

Carleton County. St. John River at McKinley Ferry, Kingsclear Parish, York County. Baker Brook, $1\frac{1}{2}$ miles East of Lincoln, Sunbury County. UMMZ: Trout Creek just East of Sussex, collector—A. H. Clarke, June 25, 1960.

Pisidium ferrugineum Prime. St. John River at McKinley Ferry, Kingsclear Parish, York County. Baker Brook, $1\frac{1}{2}$ miles East of Lincoln, Sunbury County.

Pisidium milium Held. Little Presquisle River below sawmill at Waterville, Wakefield Parish, Carleton County. Pond on Lovelly Brook, $2\frac{1}{2}$ miles South of Perth-Andover Bridge, Perth Parish, Victoria County.

Pisidium nitidum Jenyns. Little Presquisle River below sawmill at Waterville, Wakefield Parish, Carleton County.

Pisidium nitidum Jenyns, form *pauperculum* Sterki. Little Presquisle River below sawmill at Waterville, Wakefield Parish, Carleton County. St. John River at Princess Margaret Bridge, Frederickton, York County. Baker Brook, $1\frac{1}{2}$ miles East of Lincoln, Sunbury County.

Pisidium variabile Prime. Pond on Lovelly Brook, $2\frac{1}{2}$ miles South of Perth-Andover Bridge, Perth Parish, Victoria County. Lake Edward, Denmark Parish, Victoria County. Little Presquisle River below sawmill at Waterville, Wakefield Parish, Carleton County. St. John River at McKinley Ferry, Kingsclear Parish, York County. Baker Brook, $1\frac{1}{2}$ miles East of Lincoln, Sunbury County. Small tributary of the Jemseg River, $\frac{3}{4}$ mile Southwest of Jemseg, Cambridge Parish, Queen's County.

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-

A NORTHERNMOST RECORD AND ECOLOGICAL DATA ON *HYDROBIA SALSA* IN MAINE

By JAMES F. GORE

Maine Cooperative Wildlife Research Unit¹

This note reports ecological data and an apparent northernmost record for *Hydrobia salsa*, Pilsbry. Articles containing ecological data on American species of mollusks are for the most part lacking (Morrison, 1965a). Therefore, such information should be reported to help guide those studying salt marsh ecology. *H. salsa* was first described in 1905 and its type location was reported as Cohasset, Massachusetts (Pilsbry, 1905). He first called the species *Paludestrina salsa*, but *Paludestrina* has since been changed to *Hydrobia*.

The current salt marsh study was conducted under the supervision of Malcolm W. Coulter, Assistant Leader, Maine Cooperative Wildlife Research Unit, Orono, Maine, to whom I am most grateful. Special thanks are also extended to Dr. Joseph P. E. Morrison, Associate Curator of the Division of Mollusks, Smithsonian Institution, Washington, D. C., for his advice and identification of snail specimens.

The study was conducted on the Weskeag River salt marsh, located in South Thomaston, Knox County, Maine. The Weskeag River flows into West Penobscot Bay slightly southwest from the town of Rockland. The marsh is $4\frac{1}{3}$ miles from the mouth of the river, and has a normal range of high tides from 8 to 11 feet.

This marsh was drained long ago to facilitate the harvesting of salt marsh hay. Many deep (2-5 feet), narrow (2-4 feet) ditches still remain. Samples of *H. salsa* were taken from bottom samples in 9 of these ditches.

Salinity, temperature and pH measurements of the water were taken once a week from June 10 through September, 1964. The results are presented in Table 1.

Morrison (1965b) believes that these collections of *H. salsa* represent a new northernmost record for this species. Stickney (1959) reported finding *H. salsa* in the Sheepscot River estuary

¹ Maine Cooperative Wildlife Research Unit, Orono, Maine: University of Maine, Maine Department of Inland Fisheries and Game, Wildlife Management Institute, and U. S. Bureau of Sport Fisheries and Wildlife, cooperating.

Table 1. Water Analyses Data from Nine Drainage Ditches
On the Weskeag River Salt Marsh

Month	Air Temp. °C		Water Temp. °C		Salinity ‰		pH	
	Ave.	Range	Ave.	Range	Ave.	Range	Ave.	Range
June ²	19.8°C	16-22°C	17.5	14-21.5	22.5	14-30	7.3	6.7-8.2
July ³	20.9	21-26	20.1	18-26	17.6	7.5-27.5	7.1	6.5-7.6
Aug. ⁴	19.0	15.5-21	17.8	16.5-20	20.2	8-31	7.1	6.4-7.6
Sept. ⁴	19.3	16.5-22	15.9	11.5-21	20.8	12-30	7.1	6.7-7.5
Total								
Summer	21.0	15.5-26	17.6	11.5-26	19.9	7.5-31	7.2	6.4-8.2

near Boothbay Harbor, Lincoln County, Maine. This estuary is approximately 31 air miles southwest from the Weskeag study area. He found *H. salsa* on intertidal sediments and in water ranging in salinity from 0 to 27 ‰ (parts per thousand).

Hartman (1960), studying estuarine ecology at Bucksport, Hancock County, Maine, did not find *H. salsa*. However, he did find *H. totteni*, Morrison, in marsh areas along the Penobscot Estuary, about 39 miles northeast from the site of the present collection of *H. salsa*. The annual salinity for his area ranged from 2 to 18 ‰, while salinity for the summer months ranged from 8 to 18 ‰.

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² 3 weeks. ³ 5 weeks. ⁴ 4 weeks.

TWO NEW SONORELLA FROM SONORA, MEXICO

BY WALTER B. MILLER

Department of Zoology, University of Arizona

The dedicated efforts of Pilsbry and Ferriss, over a period of more than 20 years, in collecting and examining *Sonorella* in the Southwest, have provided science with a relatively excellent state of knowledge on the speciation and distribution of the genus in the U. S. By contrast, similar data for the contiguous regions of Mexico are extremely sketchy. Only 4 species are known from Chihuahua, namely *S. nelsoni* and *S. goldmani* Bartsch, and *S. pennelli* and *S. mormonum* Pilsbry; 2 more species are known from Sonora, *S. mearnsi* Bartsch and *S. magdalenensis* (Stearns).

For years, whenever an opportunity came to travel in north-west Mexico, the author gazed at the distant mountain ranges of eastern Sonora and wondered what molluscan treasures lay waiting to be discovered. On 29 Dec. 1964, a program of systematic exploration for *Sonorella* was finally begun in the region, with immediate rewards of new and interesting species. Well known U. S. species were also found established in many localities south of the border. Progress has necessarily been slow, for one cannot adequately describe new species unless one is thoroughly familiar with species already described; this, in turn, has required the collecting and dissecting of nearly every known species and subspecies, including those whose anatomy was previously unknown, such as *mearnsi*, *magdalenensis*, *ashmuni*, *superstitionis*, *neglecta*, etc. Progress is being made, nevertheless, and the following are two new species from eastern Sonora:

SONORELLA GREGGI new species.

Plate 6, figs. A-F.

Description: Shell depressed, globose, heliciform, thin, translucent, with a dull, silky sheen, more glossy at base, dilute brownish, with a chestnut spiral band on the well-rounded shoulder; umbilicate, the umbilicus contained about 8 times in the diameter. Embryonic shell of 1 and $\frac{1}{3}$ whorls covered with radial ripples upon and between which are superimposed fine radial wrinkles and round papillae; there is no trace of spiral threads; in life, the papillae bear periostracal bristles. Post-embryonic whorls with larger growth striae; the superimposed radial wrinkles break up into lengthened granules, giving a densely granular-wrinkled appearance to the entire shell; numerous papillae present on all

whorls, with periostracal bristles persisting on live, adult shells, creating a hirsute appearance. Last whorl descends markedly to the aperture. Aperture oblique, nearly circular, the peristome thin, only slightly expanded, its margins converging.

Holotype measurements: Height 10.0 mm.; max. diam. 16.9 mm.; umbilicus 2.1 mm.; whorls $4\frac{1}{3}$.

Genitalia of holotype (Plate 7, figs. C, D): The large penis contain a stout, cylindric verge with an abruptly truncate tip. The verge is prominently spirally grooved, with 13 to 14 right-handed spirals; the seminal duct orifice is terminal on the verge and is raised slightly on a short conic papilla. The epiphallus is slightly longer than the penis and bears a very small, barely detached epiphallic caecum at its junction with the vas deferens. Penial sheath $\frac{1}{3}$ to $\frac{2}{5}$ the length of the penis. Vagina about $\frac{3}{4}$ the length of the penis and about 3 times the length of the free oviduct.

Measurements of
genitalia, in mm.

	Holotype	Paratype 4788A
Penis	13.5	11.5
Verge	7.0	7.0
Penial sheath	5.0	4.0
Epiphallus	14.5	14.0
Vagina	9.5	9.5
Free oviduct	3.5	3.0
Spermathecal duct	25.0	19.0

Type locality: Sierra Purica, Sonora, Mexico, in igneous rock outcroppings in northeast-facing ravine, on south bank of large canyon which runs easterly from saddle between the two highest peaks at the south end of the range. Lat. ca. $30^{\circ} 31' N$, λ ca. $109^{\circ} 45' W$. Elev. ca. 6300 ft. (W.N. Miller and W.B. Miller, 29 July, 1965 and 27 July, 1966). Holotype ANSP 310363. Paratypes in collections of ANSP. 310364, Dept. of Zoology, University of Arizona (2564), and the author (4788, 4904).

Maximum diameter of paratype varies from 15.3 mm. in the smallest specimen to 18.2 mm. in the largest. This snail combines features of many diverse groups of *Sonorella* and has unique characteristics of its own. By the lack of embryonic spiral threads, the granular surface of the shell, and the conformation of the verge, it clearly belongs in the group of *S. granulatissima* Pilsbry.

The spirally grooved verge has been seen heretofore only in the

group of *S. tumamocensis* P. & F. The very pilose periostracum, persisting in live adult shells, is somewhat similar to that of *S. apache* P. & F.

Two other characteristics stand out as unique: (1) the mantle is strongly pigmented with large, dark-grey, polymorphic spots, from the mantle collar all the way to the apex of the hepato-pancreatic gland, similar to the pigmentation seen in most species of *Helminthoglypta* but heretofore never described in *Sonorella*; (2) the mantle collar is permeated by a greenish-yellow mucus. This coloration of the mantle collar has been observed at all times, in freshly collected animals as well as in animals kept in the terrarium, regardless of feeding or aestivating conditions. In other species of *Sonorella*, the color of the mantle collar varies among various shades of brown, orange, and white, from the deep orange of *sabinoensis* to the milk-white of *tumamocensis*.

The Sierra Purica lies to the west of the Agua Prieta-Nacozari road, about 15 to 20 road miles north of Nacozari. The type locality lies in an ecotone between the Upper Sonoran and the Transition life zones, on the eastern slope of the range, near the southern end. The vegetation consists predominantly of *Quercus arizonica*, *Q. hypoleucoides*, *Rhus trilobata*, *Arbutus arizonica*, and *Pinus ponderosa*. In the same rocks, two live specimens each of a *Sonorella* of the *hachitana* group and *Pallifera pilsbryi* Miles and Mead were also taken.

This species is named after Dr. Wendell O. Gregg, an eminent malacologist and specialist on western land and fresh water mollusks, who painstakingly taught me his technique for making stained whole-mounts of snail genitalia, and with whom I have enjoyed innumerable collecting trips.

SONORELLA NIXONI new species.

Plate 6, figs. G-I.

Description: Shell depressed-globose, heliciform, thin, glossy, light tan, with chestnut spiral band on the well-rounded shoulder; umbilicate, the umbilicus contained about 9 times in the diameter. Embryonic shell of about 1 whorl with sculpture of the *binneyi* type; its apex and first half whorl with weak, irregular radial wrinkles giving a malleated effect; the second half whorl with weakly raised striae arranged in ascending and descending spirals. Later whorls marked by light growth wrinkles and occasional scars of worn-off periostracal projections. The periostracum pre-

sents a silky, lustrous appearance. The last whorl descends sharply to the peristome. Aperture oblique, rounded, slightly wider than high. Peristome slightly expanded, the margins converging; parietal callus thin.

Holotype measurements: Height 10.6 mm.; max. diam. 17.0 mm.; umbilicus 1.8 mm.; whorls $4\frac{1}{4}$.

Genitalia of holotype (Plate 7, figs. A,B); The large penis contains a stout, cylindric verge with a bluntly rounded end from which protrudes a narrower, terminal papilla; the orifice of the seminal duct is not at the tip of the verge, but rather at the base of the terminal papilla. The epiphallus is about $\frac{3}{4}$ the length of the penis and bears a distinct, well detached epiphallic caecum. The penial retractor inserts on the epiphallus a short distance above the penis. Penial sheath about half the length of the penis.

The vagina is about $\frac{3}{4}$ the length of the penis; anteriorly, at the genital orifice, its diameter is about equal to that of the penis, ca. 1.0 mm., as is usual in *Sonorella*; posteriorly, however, the diameter increases to a maximum size of about 2.5 mm. near the junction of the spermathecal duct, giving it an overall club-shaped appearance; interiorly, the walls of the vagina have a pleated, accordion-like structure. The free oviduct is narrow and short (ca. 3.0 mm.), in the usual manner for *Sonorella*.

Measurements of

genitalia, in mm.

	Holotype	Paratype B	Paratype E
Penis	22.0	19.0	21.0
Verge	9.5	9.0	9.0
Penial sheath	8.5	8.5	7.5
Epiphallus	14.0	14.5	15.5
Vagina	17.0	15.5	14.5
Free oviduct	3.0	3.0	3.5
Spermathecal duct	16.0	21.0	20.0

Type locality: La Angostura, Sonora, Mexico, in rocks just south of the main road at the village, overlooking the west rim of La Angostura Dam on the Rio de Bavispe; elevation ca. 3100 ft. (W.N. Miller and W.B. Miller, 8 Aug., 1965). Holotype ANSP. 310361. Paratype in collections of ANSP. 310362, Dept. of Zoology, University of Arizona (2565), and the author (4796).

Other localities: In rockslide on mountain south of road from El Tajo (on Agua Prieta-Nacozari road) to La Angostura, at a

point 8.4 road miles from El Tajo, elev. ca. 4800 ft. (W.N. Miller and W.B. Miller, 7 Aug., 1965) Pilares de Nacozari, about 1 mile east of Nacozari, at base of cliffs, in rockslides; elev. ca. 4200 ft. (W.N. Miller and W.B. Miller, 30 Dec., 1964, 31 July, 1965).

S. nixon belongs to the group of *S. binneyi*. The mantle collar and the border of the foot are strongly pigmented with orange mucus, as in *binneyi* and *bowiensis*. Although the type and 5 paratypes were dissected at various times during the year, they all showed the unusual, club-shaped vagina. One specimen from Nacozari, however, did not show this characteristic; instead, it had a cylindrical vagina of relatively uniform diameter throughout. Large numbers of dissections from several populations would be required in order to determine whether the variation in vagina morphology might be of subspecific value. The shell of *nixon* varies much in diameter. Specimens from the type locality are generally larger than those from Nacozari. The largest paratype measures 19.6 mm. and the smallest, 16.1 mm. The smallest shell in a lot from Nacozari measures 15.6 mm. The embryonic spiral threads vary in intensity, but are present, at least to some degree, on all specimens examined, as in *S. binneyi*.

S. nixon most closely resembles *S. bowiensis* in shell characteristics; it has a slightly smaller umbilicus, however, and the embryonic spiral threads are generally less distinct. In the genitalia, *nixon* differs from both *bowiensis* and *binneyi* by the large size and stout shape of the verge, the terminal papilla on the verge, and the relative length of penis to epiphallus.

In *bowiensis*, the verge, examined in three topotypes, is widely cylindrical all the way to the tip, with a subterminal seminal duct orifice, but without a smaller papilla at the tip (Plate 7, fig. F); the epiphallus is as long as or longer than the penis; the vagina is narrowly cylindrical throughout.

In *binneyi*, the verge, examined in two topotypes, has a large swollen, heart-shaped tip, with a subterminal seminal duct orifice which opens in a circular depression in the side of the verge; a small, pointed papilla lies in the middle of this depression, attached to the verge at the upper edge of the depression, *above* the duct orifice (Plate 7, figs. G,H); the vagina is narrowly cylindrical throughout.

S. nixon inhabits the range of mountains between the Agua

Prieta-Nacozari road and the Rio de Bavispe. At the type locality, several specimens were found crawling over the rocks early in the morning, after a violent thunderstorm; there, it is associated with *Bulimulus nigromontanus* Dall, also crawling in the same rocks. Along the road from El Tajo to La Angostura, just south of Cerro Pinitos, it was found associated with *Sonorella walkeri* P. & F. In the Pilares de Nacozari, just east of town, dead shells of *S. nixonii*, *S. walkeri*, and *B. nigromontanus* were found in quantity, but only one live *nixonii* was collected, a moribund adult, and a clutch of eggs from which only one individual survived in a terrarium. This individual was raised to maturity in just one year. Dissection revealed genitalia similar to those of the population from La Angostura, with the exception of the uniform diameter of the vagina mentioned above.

This species is named for my son, W. Nixon Miller, who found the first specimen and whose help was invaluable in making possible several arduous collecting expeditions into the mountains of northeastern Sonora.

NEW SPECIES OF HELICODISCUS FROM VIRGINIA

By F. WAYNE GRIMM

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HELICODISCUS DIADEMA, new species. Page 123, figs. A to E.

Shell discoidal, spire flat or slightly depressed; dull greenish-brown, opaque, whorls $4\frac{1}{4}$ to 5; umbilicus wide and shallow, showing all whorls, occupying from 40 to 47% of the diameter of the shell; whorls rounded, slowly increasing, the last descending slightly; sculptured with coarse growth-wrinkles and 11 to 13 pinched spiral threads bearing prominent, curved hairs; sutures deep, impressed; aperture lunate, peristome simple, slightly thickened within; within the last quarter whorl are 2 to 3 pairs of large, radially elongate teeth, and alternating with them, 3 parietal teeth. The teeth on the outer and basal walls precede those on the parietal wall, are borne on a thick callous ridge, and separated by a deep, rounded sinus. The teeth on the outer wall are larger and more pointed than those on the basal wall. The cupped parietal teeth are twice as broad as high, the ends turned forward, and the upper end is longer than the lower. As the shell grows, the inner-

most set of teeth is absorbed and a new set appears near the aperture. In some examples, the innermost parietal tooth remains and only the innermost teeth on the outer and basal walls are absorbed.

Dimensions in mm.

Height	Diameter		Whorls
	Diameter	of Umbilicus	
1.34	4.00	1.78	4 $\frac{7}{8}$ holotype
1.09	3.26	1.30	4 $\frac{1}{4}$ paratype
1.48	4.13	1.96	5 paratype
1.22	3.70	1.61	4 $\frac{1}{2}$ paratype

Distribution: *Virginia:* Rockbridge Co.: leaf litter at base of limey shale outcrop along U. S.-60, 9.2 mi. northwest of jct. U. S.-11 at Lexington. Allegheny Co.: base limey shale outcrop 4.9 mi. west of jct. U. S.-60 and U. S.-220 at Covington; thinly wooded (*Robinia*) limestone hillside near quarry on U. S.-220, 7.6 mi. northeast of Covington city limit and 1.8 mi. southwest of Bath Co. line, holotype U.S.N.M. 683586; paratypes U.S.N.M. 683587, A.M.N.H. 128744, A.N.S.P. 310365, M.C.Z. 256812, U.M.M.Z. 228931, collection of Leslie Hubricht (35749), and collection of the author (1640).

The apertural dentition of *Helicodiscus diadema* is almost identical to that of *H. multidentis* Hubricht and *H. enneodon* Hubricht. *Helicodiscus diadema* differs from both species by having fewer, coarser fringes on the body whorl, and from all other previously described species by possessing large, curved hairs on the lirae. "*H. multidentis* has between 25 and 30 fringes on the body whorl. They are so fine that it is hard to count them accurately." (Hubricht, in litt.) The hairs wear off with age, for the youngest examples are the most conspicuously hirsute, and the old adults bear only scattered traces of their previous adornment. In the field, these hairs, visible to the unaided eye and bearing tiny droplets of condensed moisture, gave the shells the appearance of being crowned with rings of gems.

At the type-locality, *Helicodiscus diadema* is abundant in the topmost layer of damp leaf litter on an exposed, locust-scrub clad, limestone hillside. Living specimens are quite rare in the deeper layers of leaves and soil, where *H. notius* Hubricht, *H. intermedius* Morrison, and *H. jacksoni* Hubricht were found.

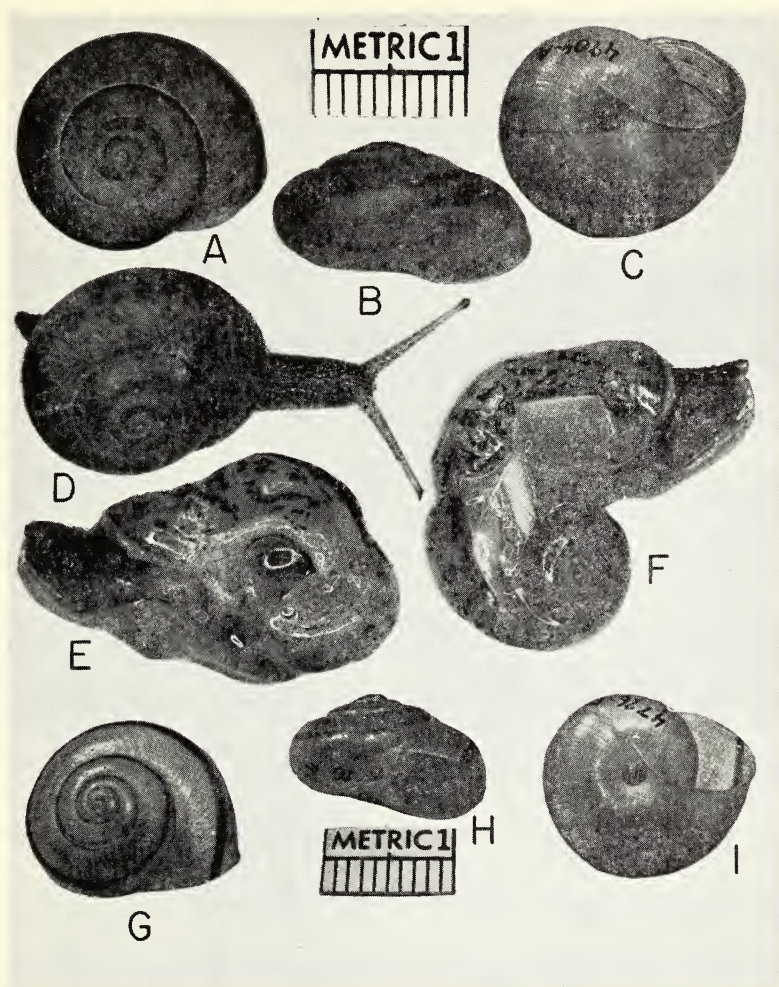


Plate 7. Lower genitalia. A. Holotype, *S. nixonii* W. B. Miller; B. Verge of paratype 4796-E. C. Holotype, *S. greggi* W. B. Miller; D. Verge of paratype 4788-A. E. Verge of *S. granulatissima* Pils. F. Verge of *S. bowiensis* Pils. G. Verge of *S. binneyi* P. & F., #4910-A, front view. H. Verge of *S. binneyi* P. & F., #4802-A, side view. ec, epiphallic caecum; ep, epiphallus; fo, free oviduct; pe, penis; pr, penial retractor; ps, penial sheath; sd, seminal duct; sp, spermathecal duct; va, vagina; vd, vas deferens ve, verge. All drawings to scale indicated, from stained whole mounts.

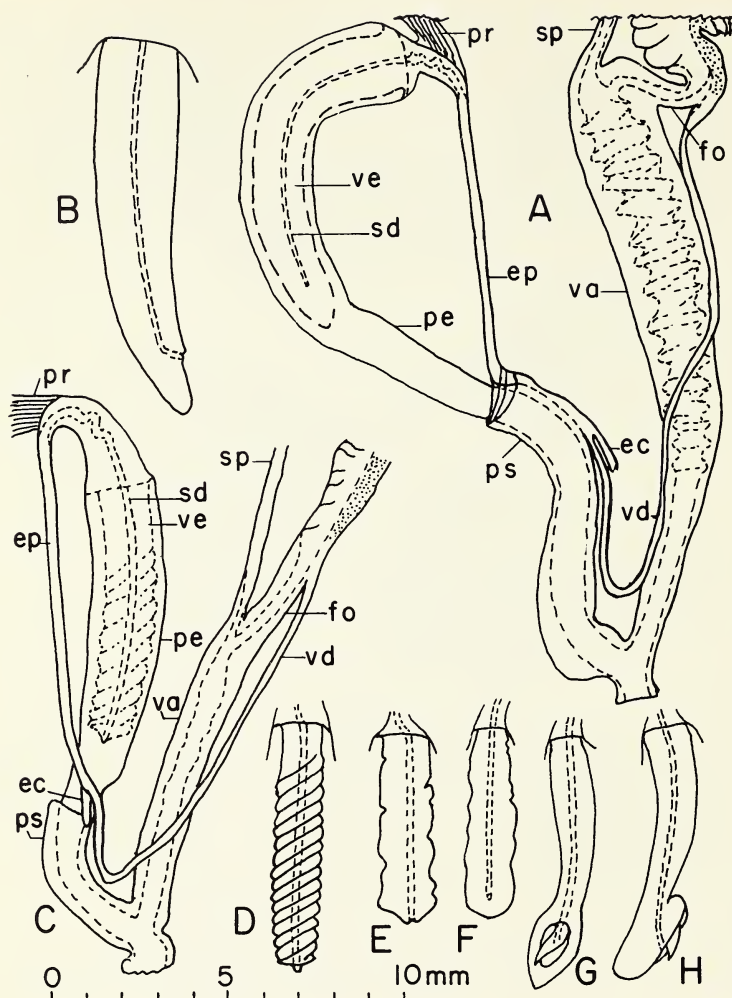
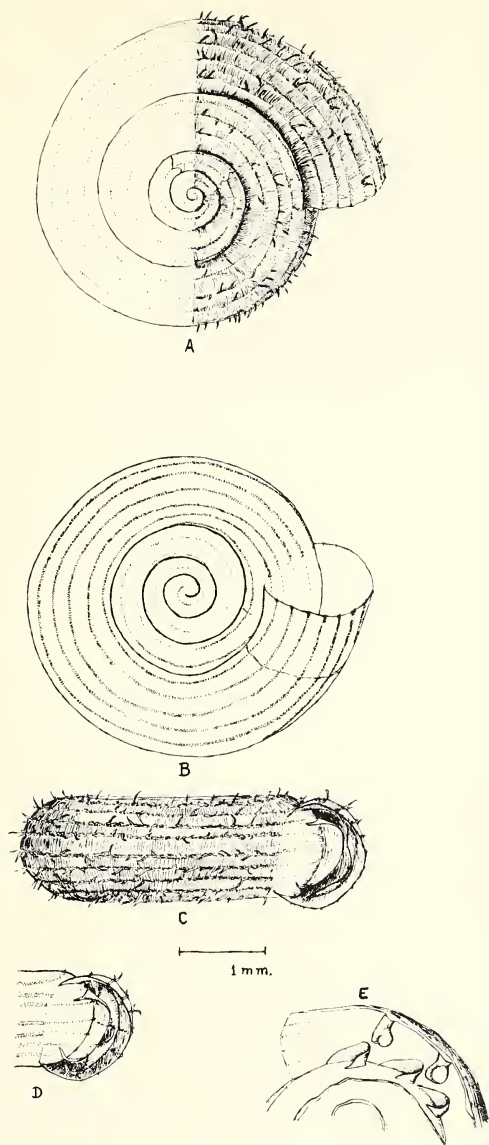


Plate 6. Holotypes. A-F, *Sonorella greggi* W. B. Miller. G-I, *S. nixonii* W. B. Miller. Upper scale for A-F; lower scale for G-I.



Helicodiscus diadema Grimm. A - C, holotype. D, aperture of paratype showing mature dentition. E, paratype, with base removed to show teeth.



FIG. 1

FIG. 2



FIG. 4

.20 MM



FIG. 5

1.0 MM

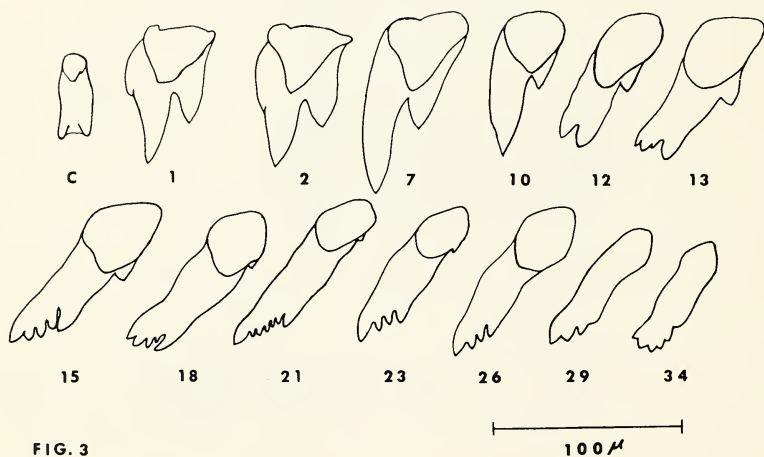


FIG. 3

100 μ

Plate 9, figs. 1-5. *Lymnaea stagnalis brunsoni* Miller. 1, holotype shell. 2, paratype. 3, radular teeth. 4, upper jaw. 5, penial complex.

A NEW SUBSPECIES OF *LYMNAEA STAGNALIS* FROM MONTANA

By RICHARD H. RUSSELL

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In recent years, extensive collecting of land and fresh-water mollusks in western Montana has resulted in many range extensions and several new varieties of recent Mollusca. The subspecies here described represents one of these new varieties.

LYMNAEA STAGNALIS BRUNSONI new subspecies. Page 124, figs. 1-5

Shell (figs. 1, 2) medium in size, color light horn; surface with fine impressed growth lines. Whorls $5\frac{1}{2}$, flat-sided; sutures indistinct; body whorl large, rounded. Spire acute, the nuclear whorl rounded. Aperture roundly ovate, elongate in immature shells. Inner lip folded over columella leaving a narrow umbilical chink. Columella with distinct plait.

Holotype: Height 28.5 mm.; width 16.0 mm.; aperture length 17.2 mm.; aperture width 11.9 mm. USNM 683584. Paratypes in the Invertebrate Museum, Department of Zoology, University of Montana, and the collection of the author.

Measurements of paratypes are as follows, in mm.:

Height	Width	Aperture Length	Aperture Width
27.3	14.8	17.0	11.1
27.7	14.8	15.6	10.8
25.4	14.8	15.5	10.6
25.3	14.5	14.9	10.5
24.9	13.8	13.9	9.7
24.4	13.6	15.3	10.3
23.7	13.5	13.7	9.7
23.2	13.8	13.9	10.0
23.2	13.2	13.8	9.5
22.5	12.2	12.8	8.6
21.9	11.8	12.8	8.7
21.2	12.5	12.8	9.0

Type locality: East shore of Flathead Lake, north of point of land at Yellow Bay; 18 miles north of Polson, Lake County, Montana. Township 24 N., Range 19 W., Section 4, Principle Meridian, Montana. Elevation 2983'. Collected during a period of extremely low water. Found 8-10 feet below usual lake level. March 26, 1966.

Animal: Mantle dark with white patches. Body grey, foot broad; tentacles broadly triangular. Other characteristics as in *L. stagnalis appressa*.

Radula and Jaw: Radula (fig. 3) with 11 laterals, first lateral tricuspid in some specimens. Mesocone of seventh lateral long and acute, becoming smaller in laterals eight through eleven. Entocone of intermediates with one to four cusps. Entocone of marginals one through 7 having from 3 to 6 cusps. Marginals 8 through 23 show a gradual reduction in the number of cusps. Formula: $23/4-6 + 3/3-4 + 11/2 + 1/1 + 11/2 + 3/3-4 + 23/4-6$ (37-1-37). In some specimens the central tooth shows a small cusp on the right side of the main cusp. Superior jaw (fig. 4) well-arched, higher than in *L. stagnalis appressa*. Median cusp worn and indistinct.

Genitalia (fig. 5): Similar to *L. stagnalis appressa*. The penis sheath retractor is inserted in the posterior preputium retractor. The preputium retractors consist of two heavy muscles. Protractors two in number. Vas deferens about seven times the length of the penis sheath and preputium. Length of preputium in holotype 3.88 mm., penis sheath 1.15 mm., vas deferens 36 mm.

Remarks: This race resembles in shell characters the Great Lakes *L. stagnalis sanctaemariae* Walker and *L. s. occidentalis* Hemphill from Lake Whatcom, Washington. However, the characters of the genitalia and radula are closer to F. C. Baker's *L. stagnalis lillianae*.

The cosmopolitan occurrence of *Lymnaea stagnalis* is probably the result of a southward ingression from a circumboreal distribution. The northern populations of this species were adversely affected by glaciation during the Pleistocene as were many other animals and plants. Few of the organisms which did survive this period were able to compete with and remain distinct from those which later moved into these areas. *Lymnaea stagnalis brunsoni* lives in a restricted environment which has existed from pre-glacial times. Anatomical and shell characters are unique among North American Lymnaeas, and some features are closer to the European forms of *Lymnaea stagnalis*. *Lymnaea stagnalis brunsoni* represents a microgeographical race and can be considered as a Pleistocene relict, probably restricted to Flathead Lake.

This subspecies is named after Dr. Royal Bruce Brunson of the Department of Zoology, University of Montana.

CARUNCULINA PULLA (CONRAD), AN OVERLOOKED ATLANTIC DRAINAGE UNIONID

By RICHARD I. JOHNSON
Museum of Comparative Zoology

The present paper is a result of a study of the Unionidae of the south Atlantic states begun in 1961 and now largely completed. All the extant types of the various named forms mentioned here have been examined and photographed. Call (1896) illustrated his paper with line drawings of all the types of *Carunculina* known at that time. Reproduced here are only the type figure of *C. pulla* and photographs of some specimens, including two topotypes of *C. patrickae*.

I wish to thank Mr. John M. Bates for allowing me to examine his specimens of *Carunculina* in the Museum of Zoology, University of Michigan, prior to the appearance of his paper declaring them to represent a new species. Thanks are also extended to Drs. K. J. Boss, W. J. Clench, and R. D. Turner for reading the manuscript of this paper and for making several suggestions toward its improvement.

The following abbreviations have been used:

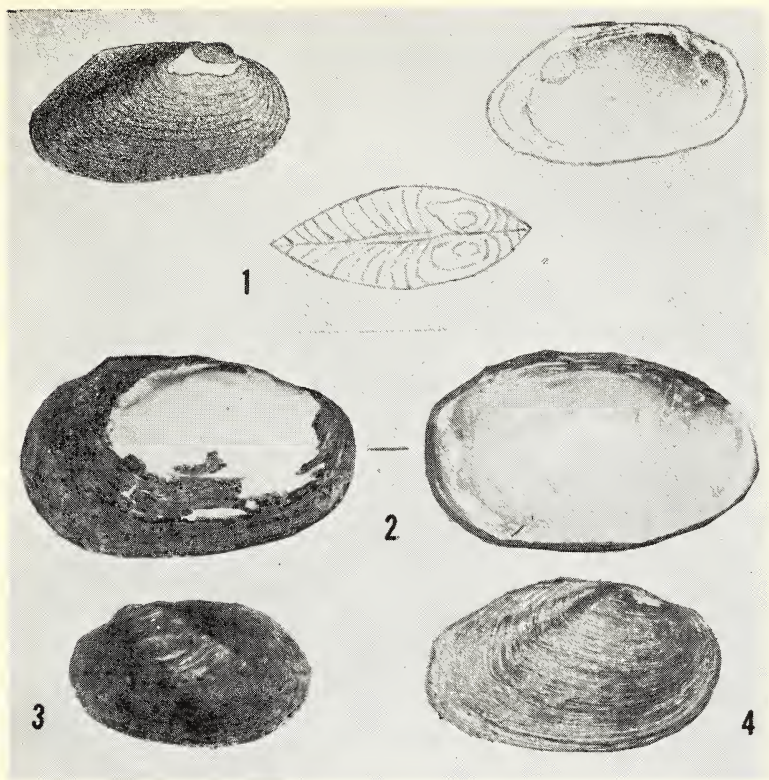
- ANSP. Academy of Natural Sciences of Philadelphia, Pennsylvania.
MCZ. Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.
UMMZ. Museum of Zoology, University of Michigan, Ann Arbor, Michigan.
USNM. United States National Museum, Washington, D. C.

Bates (1966) in his original description of this species, *Carunculina patrickae*, (Savannah River at approximately mile point 134.5 [U. S. Army Corps of Engineers Map] on the South Carolina bank, holotype UMMZ. 85274) stated that, "The beak sculpture, prominent posterior ridge and heavy growth lines clearly distinguish this species from all others in the genus." Further he erroneously contended that, "None of the 3 species (*C. pulla* [Conrad, Wateree River, South Carolina, type lost]; *C. paula* [Lea, Chattahoochee River, Columbus, Muscogee Co., Georgia, holotype USNM. 85274]; *C. minor* [Lea, Lake George, Florida, holotype USNM. 85310]) from this general geographic area (Southeastern U. S., Atlantic drainage) appear to be closely related to this form."

The Atlantic drainage *Carunculina*, *C. pulla*, was first described by Conrad (1838, p. 100, pl. 55, fig. 2, Wateree River, South Carolina). The figured type (fig. 1) was collected by Dr. William Blanding and is presumed to have been in the Academy of Natural Sciences of Philadelphia, but it is lost. The specimen mentioned by Conrad from Warm Springs [=Hot Springs, Madison Co.] North Carolina was probably a *Villosa*, and the locality is in the Tennessee River system. Conrad's figured specimen was a male shell which shows the sharp, double, posterior ridge and the prominent growth lines. The posterior ridge is especially clear in colored copies of Conrad's plate.

Call (1896, p. 109) recognized that *C. paula* and *minor* were synonyms of *Carunculina parva* Barnes, 1823 (Fox River, Wisconsin, type lost) a variable species which ranges from western New York to Minnesota, to Texas, Arkansas and Florida. He unfortunately placed *C. pulla* in the synonym of *C. glans* Lea, 1830 (Ohio River, type not found in USNM) on the basis of their both having purple nacre. Call probably never saw a specimen of *pulla* and based his synonymy on Conrad's description. Bates first pointed out that the color of the nacre varies. "Nacre salmon colored and somewhat iridescent, becoming purplish at posterior extremity." Simpson (1914, 1:160) recognized Conrad's species, but was unaware of its distribution, since it was known from very few specimens until Bates found it, in some abundance, in the Savannah River, South Carolina.

Bates did not illustrate the beak sculpture of *patrickae*, but said the beaks were, "Sculptured with sharp ridges which, posteriorly, form small double-loop ridges curving acutely upward to the very prominent posterior ridge." He further claimed that, "The closest affinity of this species would be with *C. haleiana* [Lea, 1842] (group of *C. texasensis* [Lea, 1857]) which has raised beaks that often exhibit a rudimentary posterior loop." I have examined the holotype, which was the only specimen seen by Lea, of *C. haleiana* (Mississippi River, thirty miles above New Orleans [corrected on shell by Lea to: Alexandria, Louisiana] holotype USNM 85306). The holotype is more than twice the size of any *Carunculina*, and is a male shell of *Villosa lienosa* Conrad, 1834. The beak sculpture of topotypes of *C. patrickae* do not appear to be appreciably different from *parva* in the tendency to be somewhat double looped.



Figs. 1-4. *Carunculina pulla* (Conrad). 1, from Wateree River, South Carolina. Type lost. Length 33, height 19, width 13.5 mm. Male. Figures after Conrad. 2, from Savannah River, Johnsons Landing, 10 mi. W. Allendale, Allendale Co., South Carolina. MCZ. 255220. Length 32, height 19, width 15.5 mm. Female. A topotype of *C. patrickae* which lacks the sharp posterior ridge. (1.25 x). 3, from Savannah River, Johnsons Landing, 10 mi. W. Allendale, Allendale Co., South Carolina. MCZ. 255222. Length 22, height 13.5, width 10 mm. Male. A topotype of *C. patrickae* which closely resembles Bates' sketch of the allotype. 4, from University Lake, an empoundment on Morgan Creek, 1 mi. W. Chapel Hill, Orange Co., North Carolina. MCZ. 261347. Length 25, height 17, width 11 mm. Male. Specimen showing strong, double, posterior ridge.

The only characters which tend to distinguish *Carunculina* in the Atlantic drainage from typical *parva* are the sometimes heavy growth lines, and a generally present, sharp posterior ridge with a second less prominent ridge above it. Most probably the growth lines are caused by environmental conditions. The posterior ridge is not usually present in typical *parva*, and when it is, it is generally not as acute as in the Atlantic drainage form. Occasional specimens of *C. pulla* have an indistinct posterior ridge, as does one of the topotypes of *patrickae* figured here. Nevertheless, the sharp posterior ridge is so generally present, that the Atlantic drainage form of *Carunculina*, *C. pulla*, can be resognized as a species in the modern sense, with *C. patrickae* as a synonym of it. *C. pulla* is relatively isolated from *parva* in its distribution.

Distribution: Atlantic drainage: Altamaha River system, Georgia to the Neuse River system, North Carolina. *C. parva* is abundant in Black Creek, northern Florida, but no *Carunculina* have been reported from the two systems, the St. Mary's and Satilla, between Black Creek and the Altamaha River system. To the north no *Carunculina* have been found in the Atlantic drainage beyond the Neuse River. Presumably the ancestors of *C. pulla* entered the Atlantic drainage through a mingling of the headwaters of the Chattahoochee and Savannah River systems.

Specimens of *C. pulla* examined.

ALTAMAHA RIVER SYSTEM

Ocmulgee River drainage, Georgia: Ocmulgee River, below Lumber City, Telfair Co. (H. D. Athearn).

Altamaha River drainage, Georgia: [Altamaha River] Darien, McIntosh Co. (USNM.).

SAVANNAH RIVER SYSTEM

Savannah River drainage, South Carolina: Savannah River, approximately mile point 134.5 (U. S. Army Corps of Engineers Map) = Johnsons Landing, 10 mi. W. Allendale, Allendale Co. (UMMZ. and MCZ.; figs 2 & 3)

SANTEE RIVER SYSTEM

Wateree River drainage, North Carolina: [headwaters of] Catawba River; Pfeiffers Pond, Stewarts Pond, Bissels Pond, Beaver Creek, all Charlotte, Mecklenberg Co. (all ANSP.). South Carolina, Wateree River (Conrad).

CAPE FEAR RIVER SYSTEM

New Hope River drainage, North Carolina: University Lake, an empoundment on Morgan Creek, 1 mi. W. Chapel Hill, Orange Co. (MCZ., fig. 4)

NEUSE RIVER SYSTEM

Neuse River drainage, North Carolina: Neuse River, Raleigh, Wake Co. (Lea).

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NOTES ON CYCLOSTREMISCUS SCHRAMMII

By JOSEPH HOUBRICK

Department of Biology, University of Miami

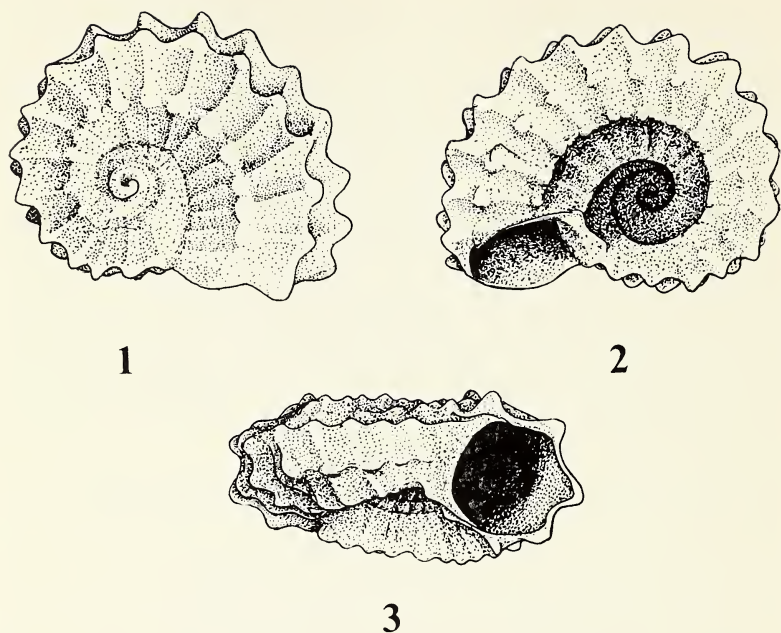
Cyclostremiscus schrammii (Fischer) has not been discussed or illustrated since it was first described and figured by Fischer in 1857. Olsson and McGinty (1958) merely included it in their check list of the marine mollusks of the Caribbean coast of Panama. Dr. Donald R. Moore, personal communication, informed the writer that he made a search for Fischer's types of Vitrinellidae while at the Laboratoire du Malacologie in Paris in 1963. *C. schrammii* (Fischer) was not found, and is either lost or misplaced.

Fischer placed this species in the genus *Cyclostrema*, but Olsson and McGinty (1958) included it under the genus *Cyclostremiscus*. Fischer's original description is confusing and his illustration is poor. Since nothing seems to have been recorded about this species since Fischer's publication, his original description is given here along with an augmented description, new figures, and an additional locality record.

"*Cyclostrema schrammii*."

Figs. 1 to 3.

"Planorbid-like shell, compressed, orbicular, horn-white, widely umbilicate; adorned with strong, radiating ribs, a median crested keel with insertion of ribs, and with two keels, one situated above, one below, with worn nodes. Three turns, rounded aperture;



Figs. 1-3, *Cyclostremiscus schrammii* (Fischer). 1, upper, 2, lower, and 3, apertural views. Diameter 1 mm.

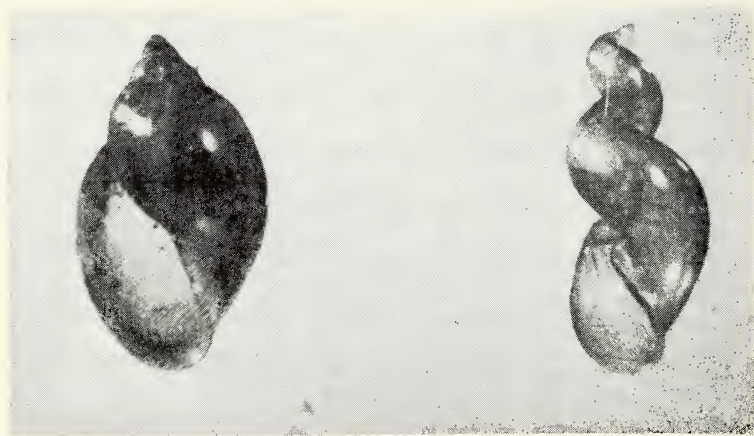


Fig. 4. *Physa anatina* (p. 144). Usual and scleriform shells.

pointed right margin. Dimensions: 8/10 mm. to 1.00 mm. Habitat — Guadeloupe."

Fischer further stated that *G. shrammii* resembles a small ammonite with 3 rows of spines and an elegant form.

The writer found 7 specimens in beach drift collected at Portete, Limon Province, Costa Rica, during the month of July, 1966. Judging from the amount of beach drift sorted and the paucity of specimens taken, this species of vitrinellid may be equally uncommon in its natural state.

The specimens are white, translucent and shining, show a convex spire little elevated except for the protoconch, and a moderately obtuse apex. There are about $2\frac{1}{2}$ whorls, the last one being wide and elevated above the spire. Each whorl has five rows (keels) of nodes. Of these, there are two rows on the periphery of the whorl, one row on the upper surface, and two below, the second of these two being weaker and bordering the umbilicus.

Since the holotype is missing, the specimen illustrated (figs. 1-3) in this paper has been deposited in the Division of Mollusks, U. S. National Museum.

Acknowledgements — The writer wishes to thank Donald R. Moore of the Institute of Marine Science, University of Miami, for his help and direction in the preparation of this paper.

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Olsson, Axel A. and McGinty, Thomas L., 1958. Recent marine mollusks from the Caribbean coast of Panama with the description of some new genera and species Bull. Am. Paleontol., vol. 39, n. 177: 1-58, pls. 1-5.

EROTOLOGY OF THREE SPECIES OF PRATICOLELLA, AND OF POLYGYRA PUSTULA

By GLENN R. WEBB

Kutztown State College, Kutztown, Pa.

The present paper deals with the courtship, mating, and sex-organ functioning of *Praticolella mobilians floridana* Vanatta, *Polygyra pustula* (Férussac), *Praticolella berlandieriana* (Moricand) and *P. griseola* (Pfeiffer). The data on the last two species is further supplemented by studies on development patterns of genitalia. This part of the work was done at the University of

Oklahoma in the Zoology laboratory; I am indebted to Drs. Harley P. Brown and John T. Self for permitting me to use a large portion of the available table-space for concrete snail-cages and otherwise aiding in the procurement of research supplies. I am also indebted to the Graduate College and Dr. Carl D. Riggs for a research assistantship on the Biological Survey staff which made my presence at the University possible. Since these data were not directly involved in an already somewhat lengthy thesis, they are presented here with additional data which has accumulated and seems to be adequate to justify publication at this time, particularly since the specific validity of some of the taxons are currently under evaluation (Hubricht, 1961, p. 29-30).

Because the configuration of the genitalia of *P. berlandieriana* just prior to maturity is seemingly nearly like that of *P. griseola* at maturity, a study of random samples of the genitalia of the two taxons may be misleading and inadequate in evaluating taxonomic status (compare figs. 18 and 24). For such a study, both the configuration of the developing genitalia and of the functioning sex-organs of topotypic material seem mandatory. My data do not qualify for such a study because topotypic material was not available; yet the data do indicate differences of genitalia in the two taxons, and imply that a sex-organ barrier to inter-mating could exist. Any study of typotypic material should test this possibility: Can these two cross-copulate and effectively cross-fertilize? Any hybrids secured, further, would have to demonstrate an ability to reproduce either among themselves or with the parental stocks.

For the above reasons, the present data are pertinent but not final on the question of inter-species distinctness of *berlandieriana* and *griseola*. The data illustrate the dangers of bland statements of taxonomic conclusion not supported by verifying evidence. To an increasing degree, the literature of modern malacology may not benefit from the publishing of bare opinions, despite the ubiquity of such procedures in the past decades.

Praticolella berlandieriana: The material was collected Dec. 21, 1953 on the bluff above Comal Creek, at New Braunfels, Comal Co., Texas. The specimens were active on dead vegetation, especially compositae, other forbs and grass following fog and light rain; none were noted near the creek. The mating-anatomies were from collected specimens; the genital development series was de-

rived partly from laboratory-raised young.

On Jan. 5, 1954 a pair were noted head-on suspended from the cage cover-glass; the sex-organs quickly everted and almost immediately the two snails sexually disengaged and separated. Then another pair was noted head-on. Boiling water now being at hand, when the penes engaged a moment later, the pair was scraped off the cover-glass into the boiling water to fix the exerted organs in the extended condition. As observed, the engaged penes seemed not to entwist but to evert into reciprocal contact as in species of *Euchemotrema* (Webb, 1947, 1948). A fellow student at this time, Virgil Dowell, then placed a pair head-on and they exerted the penes into contact a few seconds later, and provided another pair of mating-anatomies.

On Jan. 6, 1954 another glimpse of courtship was secured when a pair of specimens were noted head-on, biting at each other. Biting had not happened in previously noted courtships. The pair soon separated, however, without mating.

Mating-anatomy data: Four mating-anatomies have been available for study; three are illustrated (figs. 22, 23, 30). In two mating-anatomies the main part of the penis, essentially the basal half of the retracted organ exclusive of the accessory gland, appears pendant on a stalk-like part. The stalked condition is probably due to the exerted organs having been withdrawn into the aperture of the shell as the bodies of the snails cooled. As shown in figure 23, the complete eversion of the atrium causes the nominal vagina to open as a pore high up on the side of the everted sex-organs near the atrium. The main bulk of the exerted sex-organs is made up of the basal penis. In non-mating anatomies, a circular, lobed pilaster (basal discoid body) occupies the basal part of the penis, and forms the body of the everted penis; it holds the orifice of the accessory gland, and from its mass everts the recurved, digitiform, apical penis which terminates in the ejaculatory pore. Inside the apical penis are the descended parts of the epiphallus-vas deferens complex. I interpret the basal discoid body to be homologous to the penis-clasping disk or organ in *Ashmunella* (Webb, 1954).

The orifice of the accessory gland of the penis would seem to receive the penis tip and ejected semen from the mate; how far into the accessory gland lumen [if at all] the penis tip enters

must be determined by further observations.

The bulk of the accessory gland descends passively into the everted basal penis. In form the accessory gland may be nearly straight or recurved (figs. 30, 22, 23). The lumen of the gland is variably capacious, and its size in the mature, resting anatomy causes the penis tip to seem to insert laterally and to be $\frac{1}{2}$ to $\frac{1}{3}$ as large as the gland Pilsbry (1930) has shown; he did not describe the internal parts of the sex-organs.

Praticolella griseola: I am indebted to Jim Campbell for helping to collect part of the specimens. All were taken Dec. 24, 1953 from Harlingen, Cameron Co., Texas, or were offspring raised in the laboratory. The first courtship was seen Jan. 3, 1954, when two snails were noted head-on clinging to the cage cover-glass. The foreparts were detached from the glass. The pair lost each other while pivoting. On Jan. 4, another head-on pair were noted as before, and head arching and biting followed, the foreparts of each being detached from the glass and the jaws making biting actions at the other. This was a mutual behavior. They wandered apart after pivoting.

On Jan. 5th, again a pair were noted head on, biting at each other, with foreparts detached from the cage cover-glass. A few seconds later they were noted with the sexual organs exerted but were found to have become sexually disengaged a few seconds later, and on Jan. 8th a head-on pair also were noted to suddenly evert the sex organs which attained a marked volume relative to that of the snails. Two entwining processes spiralled horizontally free from the main mass of the united penes. The pair were plunged into boiling water and mating anatomies were secured (figs. 31, 32). The eversion of the organs had required only seconds.

No more matings happened to be observed. On Jan. 23, 1954 large numbers of young, which were not hirsute, were seen appearing in the cage. Many dead and dying adults were noted in the cage on Feb. 17, 1954. Prolonged exposure to moisture, with temperatures in excess of 74° F., are seemingly fatal, and possibly so at even lesser temperatures. This seems also true of *P. berlandieriana*. In the culture of these two taxons, alternate wet-dry periods are indicated as being necessary.

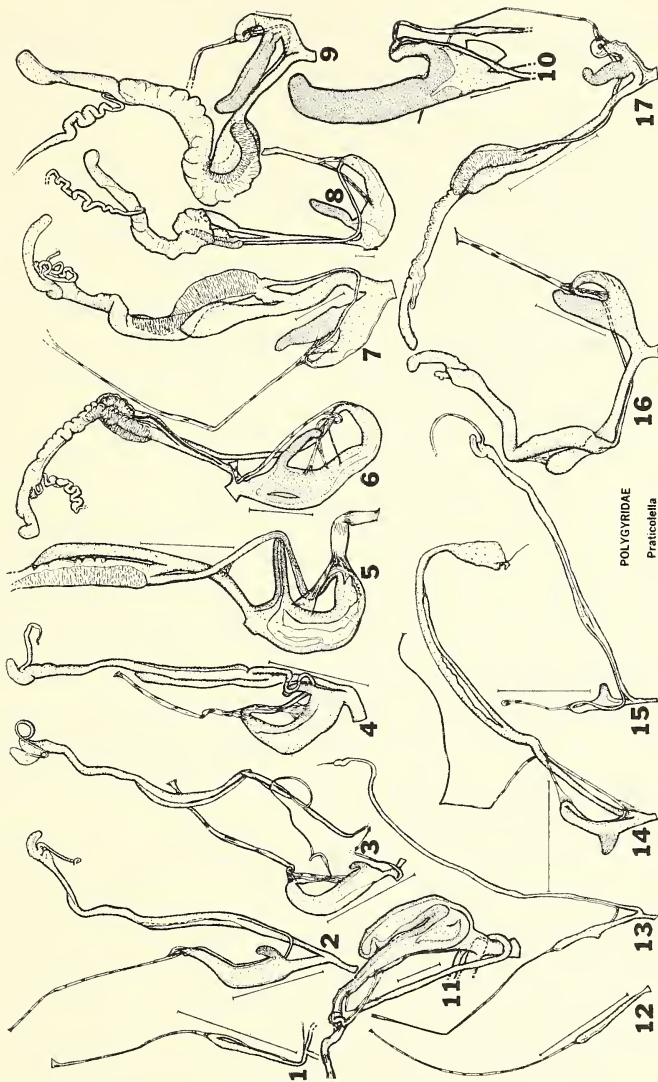
Mating-anatomy data: Two mating anatomies were available (figs. 31, 32). The anatomy shown in fig. 32 is probably abnor-

mally elongate below the atrium due to the extruding organs being drawn into the aperture of the shell as the body of the killed snail cooled. The mating anatomy of fig. 31 is believed not to exhibit this defect. The female-organs (vagina, free-oviduct, and basal spermathecal duct) are not everted, although the orifice of the vagina opens onto the side of the everted penis just below the atrium, and to this degree the nominal vagina has descended into the everted penis. The discoid body of the basal penis is seemingly ring-like (fig. 24, 25) and bears a more enlarged edge-lobe than in *berlandieriana*. This causes the edge of the main body of the penis, the basal part, to be calicular, with the narrowed orifice of the accessory gland opening on the rim of the cup. A mass of material occupies the orifice and adjacent duct in the anatomy of fig. 31, but less conspicuously so in fig. 32. The body of the entire accessory gland occupies the interior of the basal portion of the penis. The proportionately smaller accessory gland in *griseola* is about half the length of the everted penial tip, whereas in *berlandieriana* the tip is larger than the gland. The penis tip, as in *berlandieriana*, is everted from the basal penis, but is much larger and more elongate, being narrowly funnel-shaped. The tip seems not intrinsically recurved as it is in *berlandieriana*. The epiphallus and vas-deferens which are merged indistinguishably, open to the exterior at the ejaculatory pore at the tip of the everted penis-tip. In both, semen is visible in these ducts.

No semen is present in the slightly enlarged part of the vas deferens at its point of seeming origin from the base of the prostrate. In most preparations the path of the sperm duct above the vas deferens is not evident in macroscopic, whole mounts of the entire genitalia. But in the two available mating-anatomies, conspicuous masses of semen are present in the sperm duct just above the point at which the vas deferens hangs and appears as a free tube parallel to the free oviduct and vagina. A restudy of the *berlandieriana* slides fails to reveal a comparable feature, due possibly to less perfect staining and tissue clearing, or to the semen having already been discharged. The semen mass above the vas deferens in *griseola* is about as wide as the prostate, but only about half as long. The material is more copious in one example than the other. In one a thin line of the material seems to reveal the path of the sperm duct up to about the region of the insertion of the hermaphroditic duct at the talon.

The mode of seminal transfer during mating is not clearly evident. The seeming entwisting of tubular bodies noted during one mating may have been the eversion and entwistment of the penial tips. The narrowed tip of the everted penis is about as large as the accessory gland pore, but its situation in the rim of the basal disk would seem to render it difficult for the everting, entwisting tip of the penis to engage the pore of the gland. Semen transfer seems mechanically different than in *berlandieriana*. Possibly the horizontally entwisting, tips merely eject semen into the cup-like basal penis; then accessory gland secretions cement the deposited semen to the cup to facilitate engulfment and withdrawal as the entire organ is retracted.

Heretofore, data on the genitalia of *P. griseola* seem not to have been published. The uterus, prostate, albumen gland and talon are as in *berlandieriana*. In some dissections, the spermatheca in *berlandieriana* is more inflated and egg-shaped; none of those available from *griseola* showed this feature. In comparing adult *griseola* with *berlandieriana*, one may characterize the anatomical differences thus: in *griseola* the penial tip is larger than the accessory gland which is lateral; the penis retractor trifurcates before its insertion on the epiphallus-penis junction and sends two strands (penis-retentor muscles) on each side of the vas deferens to the central part of the main body of the penis. At this point the two strands may radiate variously just before insertion on the penis side (figs. 20, 24, 25). I have never found such a pronounced trifurcation of the penis retractor in *berlandieriana*; the retractor continues as a main mass to an insertion on the epiphallus-penis junction with a minor strand, sometimes two strands, (penis-retentor muscles) reaching the basal penis. In the Polygyridae, the trifurcation of the penial retractor is exhibited in species of *Allogona*, *Vespericola*, *Cryptomastix*, *Trilobopsis*, immature *Euchemotrema*, and probably others. For this reason the trifurcate condition is probably a primitive one, but not the most primitive. The condition seems correlated with a massive basal disk, and a rather elongate, sometimes verge-bearing penial tip. The retentor strands probably aid the retraction and retain or prohibit too much eversion of the everting, penial disk; especially when the penis tip is further everted therefrom. Because the epiphallus and lower part of the vas deferens must descend into the penis to permit eversion of the penial tip the retentor strands in *P. griseola*



Figs. 1-6, 8, 11. *Practicolella griseola* (Pfr.), Harlingen, Cameron Co., Texas. 1-6, 8, development of genitalia. 11, adult genitalia. Figs. 12-17. *P. berlandieriana* (Moricand), New Braunfels, Comal Co., Texas. Maturation shown in figs. 7, 9 and 10.

may not insert diffusely but must insert to leave the epiphallus-vas deferens free to move; the insertion of the retractor muscle near the penis tip at the epiphallus-penis union prohibits excessive eversion, and probably aids the retraction of the penis tip. In *berlandieriana* the penis-retractor muscle system is thus believed to have lost the trifurcate configuration. The changed muscle structure may help cause the recurvature of the everted penial tip toward the orifice of the accessory-gland, and to prohibit twisting such as occurs in the everting tip in *griseola*. The changed condition in *berlandieriana* is indicated by the potentially trifurcate condition (fig. 7) at one stage of organ development; the final condition is probably adapted to the changed organ function which is evolving in *berlandieriana*.

(To be continued)

NOTES AND NEWS

RUTH E. COATS, 1911-1966 — Conchology suffered a severe loss in the passing of Miss Ruth E. Coats. Ruth was born on March 2, 1911, in Seattle, Washington, and passed away on Oct. 19, 1966, in Carlsbad, California. Surviving are her mother, Mrs. Emma Coats of Carlsbad, and two brothers.

Ruth received both a Bachelor of Science and a Master of Science degree from the University of Washington. She had a major in zoology and a minor in geology. She taught geology for a number of years at Palomar College.

Ruth Coats was the first elected chairman of the American Malacological Union, Pacific Division. Her first meeting, in 1949, was held in the Long Beach Municipal Auditorium, but Ruth was hospitalized and unable to attend. Later she served as Secretary-Treasurer of the A.M.U.P.D. for several years. In 1954, Miss Coats was President of the Conchological Club of Southern California. She conducted a shell study class at the Burch home.

The shell house at Carlsbad, California (some would call it a museum) reflected her originality. It was remarkable for its artistic beauty and contained an excellent library of many rare volumes. Around 1950, she bought the famous Raymond Collection. In 1954 she purchased the superb second Belle Whitmore collection. These were added to her large collection made over the years from personal collecting, purchase, and by exchange — *Rose L. Burch*.

JOYCE ALLAN (in private life, Mrs. H. W. Kirkpatrick) died on September 1, 1966, after a long illness, in Sydney, Australia. She was Curator of Mollusca at the Australian Museum from 1944 to 1956, and was author of "Australian Shells" and "Cowry Shells of World Seas."

N.S.F. GRANTS. — The following is a list of malacologists or those working in aspects of molluscan research who have received awards from the National Science Foundation. This information was extracted from the section on Biological and medical science research projects of the category of Basic research support from the recently published report "National Science Foundation, grants and awards for the fiscal year ended June 30, 1965."

Arnold, John M. Influences of the egg cortex on the development of the molluscan embryo (GB3202); 36 months; \$35,900. Iowa State Univ. of Science and Technology.

Burch, John B. Biological studies of Thiaridae (GB3006); 12 mos.; \$6,900. Univ. of Michigan.

Burch, John B. Cell and tissue culture methods for mollusks (GB3133); 24 mos.; \$15,000.

Burch, John B. Cytotaxonomic studies of aquatic pulmonate snails (GB787 — Amend. No. 1; \$14,000. Univ. of Michigan.

Costlow, John D. Environmental effects on larval development and shell formation in "*Littorina picta*" Philippi (GB3270); 24 mos. \$26,300. Duke Univ.

Costlow, John D., Jr. Environmental effects on larval development and shell formation in "*Littorina picta*" Philippi (GB3270 — Amend. No. 1); \$12,800. Duke Univ.

Franzen, Dorothea S. Recent Succineidae of central North America (GB2715); 36 mos.; \$13,900. Illinois Wesleyan Univ.

Friedl, Frank E. Nitrogen catabolism in the snail "*Lymnaea stagnalis jugularis*" (GB3158); 24 mos.; \$11,300. Univ. of South Florida.

Levins, Richard and Heatwole, Harold. A study of insular populations (GB2906); 36 mos.; \$25,800. University of Puerto Rico.

Hanna, G. Dallas. Biological effects of the Alaska earthquake (GB3533); 6 mos.; \$32,600. California Academy of Sciences.

Harry, Harold W. Systematic studies on selected taxa of fresh and brackish water mollusks (GB2753); 24 mos.; \$19,200. Texas A and M Univ.

Hillman, Robert E. Comparative study of free amino acids among allopatric populations of "*Crassostrea virginica*" (GB2724); 24 mos.; \$5,100. Univ. of Maryland.

McClary, Andrew. Cues involved in vertical movement and static orientation of Gastropods (GB3672); 24 mos.; \$9,000. Michigan State Univ.

Mead, Albert R. Population decline and decimation in "*Achatina fulica*" (GB3768); 12 mos.; \$20,100. Univ. of Arizona.

Mellon, DeForest, Jr. Reflex pathways in the surf clam (GB3623); 24 mos.; \$14,800. Univ. of Virginia.

Moore, Donald R. Systematics and zoogeography of western North Atlantic Caecidae (GB3104); 12 mos.; \$11,100. Univ. of Miami.

Olsson, Axel A. and Woodring, Wendell P. Comparative study of molluscan faunas of Tertiary stages (GB3892); 4 mos.; \$6,800. Smithsonian Institution.

Solem, G. Alan. Classification and zoogeography of the Endodontidae (GB3384); 24 mos.; \$20,500. Chicago Natural History Museum, Chicago. — KENNETH J. BOSS.

TURBONILLA SECURA. — Under different authorship, *Turbonilla* (*Strioturbonilla*) *secura* was twice proposed as a replacement name for *Turbonilla obeliscus* Gould. Though the species is South African, all critical references were published in the North American literature. A brief synonymy is as follows:

Turbonilla (*Strioturbonilla*) *secura* Dall and Bartsch, 1906.

1861. *Turbonilla obeliscus* Gould, Proc. Boston Soc. Nat. Hist., v. 7, p. 406. Not *Chemnitzia obeliscus* C. B. Adams, 1850, Contrib. Conch, p. 72. [*Turbonilla* (*Strioturbonilla*) *obeliscus* (C. B. Adams)].

1906. *Turbonilla* (*Strioturbonilla*) *secura* Dall and Bartsch, Proc. U. S. Nat. Mus., v. 30, p. 339. (Replacement name.)

1915. *Turbonilla* (*Strioturbonilla*) *secura* Bartsch, U. S. Nat. Mus. Bull. 91, p. 76, pl. 17, fig. 7. (Replacement name.)

1964. *Turbonella* (sic) (*Striothurbonilla*) (sic) *secura* "Bartsch" Johnson, Smithsonian Inst. Bull. 269, p. 147 —

JAMES X. CORGAN, Sinclair Oil and Gas Company, Tulsa, Oklahoma.

FURTHER COMMENTS ON *BRACHYSTYLOMA CARIBBEANA* — The genus *Brachystyloma* and the type species *B. caribbeana*, from the Abisinia Formation (Pleistocene) of northern Venezuela, were named, described, and illustrated by Weisbord (1962, *Bulls. American Paleo.*, 42 (193): 18, 28, 335-337, 485, pl. 29, figs. 23-24). Three specimens were available for study, all badly worn and broken on the outer lip and spire. On all three specimens also, there is a deep and wide excavation under the columella, imparting to the aperture and anterior canal the outline of a broad inverted and reversed comma. Mainly on this character, the genus *Brachystyloma* was erected. After examining one specimen of *Brachystyloma*, the holotype, Robertson (*Nautilus*, 77 (1), p. 32) came to the conclusion that the character in question "is an erosional feature that would be found only in broken and abraded shells," that "*Brachystyloma* is a worn and badly broken columbellid probably the abundant and variable *Anachis* (*Costoanachis*) *hotesieriana* Orbigny or a closely related species in the same subgenus," and that "*Brachystyloma* Weisbord (1962) is a subjective junior synonym of *Anachis* H. & A. Adams (1853) and of *Costoanachis* Sacco (1890)."

Only recently, I happened to read Robertson's note or I would have commented on it earlier. I might state at the outset, that at the time I was working on the shells, I too was apprehensive that the peculiar shape of the aperture might be due to weathering rather than to its genetic structure; and, if the excavation under the columella is attributable wholly to erosion (or, as I once thought, to a burrowing organism), then the validity of the genus *Brachystyloma* is indeed questionable. However, after re-examining the two topotypes in our collection at Florida State University, I am again persuaded that the "excavation" is a true morphologic character and not a fortuitous one. It would be more than passing strange for all *three* specimens of *B. caribbeana* to be eroded or burrowed into in exactly the same complex pattern, and I must contend that the inverted comma effect is an inherent one. Secondly, breakage cannot be invoked to account for the excavation, since sharp, ragged edges are not present in the critical areas as one might expect along breaks, but are rounded and thickened instead. Thirdly, the smooth, slightly arcuate columella seems to me to be foreshortened naturally, and extends down into the

aperture as a small projection considerably distant from the basal lip. The lower end of the columella is subtruncate and is thickened or emarginate, the emargination continuing along the edge of the lower and basal lips. Truly the spire of *Brachystyloma* resembles that of *Anachis* (*Costoanachis*) as stated by Robertson, and even the residual color pattern of our specimens is similar to that of *A. hotessieriana* (Orbigny). However, the aperture of the Venezuelan shells is completely different than that of *Anachis* (*Costoanachis*), and is so unique (genetically, in my judgment) that the new genus *Brachystyloma* was proposed. — NORMAN E. WEISBORD, Florida State University.

COILING ABNORMALITY IN *PHYSA ANATINA*. — On October 15, 1965, the junior author, searching for tardigrades on some flat rocks (heavily laden with algae), inadvertently transported the eggs of *Physa anatina* Lea to his laboratory. The eggs hatched. Among the hundreds of normal individuals, a single "un-coiled" individual was observed (page 132, fig. 4). It measured 5.5 mm in greatest length. — BRANLEY A. BRANSON, Eastern Kentucky University and CLARK W. BEASLEY, University of Oklahoma.

MONTACUTA FLORIDANA COMMENSAL WITH ANNELID ONUPHIS MAGNA. — A number of bivalve mollusks of the eulamellibranch superfamily Erycinacea have been found in symbiotic association with annelids. Boss (1965, *Malacologia*, 3: 183-195) has reviewed these occurrences. Along the Atlantic coast of North America, Stimpson (1855, *Proc. Boston Soc. Nat. Hist.*, 5: 110-117) first described *Lepton* [*Ceratobornia*] *longipes* as occurring in the "holes of marine worms and fossorial crustaceans." More recently Sanders *et al.* (1962, *Limn. and Oceanogr.*, 7: 63-79) found *Aligena elevata* (Stimpson) attached to the lower end of *Clymenella torquata* (Leidy) at Barnstable Harbor, Massachusetts. The present note documents the commensal relationship of *Montacuta floridana* Dall with the annelid *Onuphis magna* (Andrews). Specimens of these species in association were collected in a muddy sand bar about 200 yards south of the mouth of Hall's Creek (south of Matheson Hammock, Dade County, Florida). The burrows of *O. magna* at this locale were among *Thalassia* rhizomes. The substrate below the thin layer of detritus and mud was anaerobic.

Additional specimens from the northwest coast of Florida were obtained from Dog Island Reef (east of Dog Island, Franklin County) in depths from 5-20 feet in sand and sand-mud substrates. At these stations, adult *M. floridana* were found at the distal end of the tube constructed by *O. magna*.

Montacuta floridana was described and figured by Dall (1899, Proc. U. S. Nat. Mus., 21: 873-897) from specimens found on the beaches of west Florida near the Manatee River by Charles T. Simpson. The type-lot consists of 6 specimens, 3 left and 3 right valves, all unmatched; the holotype (see Dall, pl. 87, fig. 10) consists of a right valve (USNM 64456).

Immature specimens from 0.5-1.0 mm. length of *M. floridana* from Hall's Creek are apparently attached to *Onuphis* and are ovate in outline. Allometric growth of the shell accounts for the difference in the shape of the valves of the adult clam which attains a length of 20 mm. and which is elongate. The dentition of this species consists of a protuberant cardinal tooth in the left valve which anteriorly interlocks with a similar tooth in the right valve. Posteriorly an internal resilial ligament conjoins the valves. The dentition is much like that of *M. phascolionis* Dautzenberg as illustrated by Deroux (1961, Cahiers Biol. Mar., Roscoff, 2: 99-153, fig. 4). Anatomically the presence of single right and left ctenidia indicate the montacutid affinities of this species (Thiele, 1935, Handb. sys. Weichtierkunde, vol., 2, p. 874). One of us (Stewart) is preparing a detailed study of the anatomy, morphology, and ecology of this species. — K. J. BOSS, Harvard University, N. K. EBBS, Institute of Marine Science, University of Miami, and W. C. STEWART, University of California, Santa Barbara.

MARINE BIOLOGICAL ASSOCIATION OF INDIA is holding a Symposium on Mollusca January 12-16, 1968, at Mandapam Camp, Ramnathpurum District, South India. All phases of studies on mollusks will be included. Anyone interested should write the Convener. I have agreed to serve on the Advisory Committee and am planning to attend. — RALPH W. DEXTER, Kent State University, Kent, Ohio 44240.

PUBLICATIONS RECEIVED

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- Clarke, Arthur H., Jr. 1965. *Amblema* Rafinesque, 1820 (Lamelibranchiata): proposed addition to the official list and proposed suppression of *Amblema* Rafinesque, 1819. Bull. Zoo. Nomencl. 22: 196-197.
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